SURGICAL PAPERS

BY

WILLIAM STEWART HALSTED

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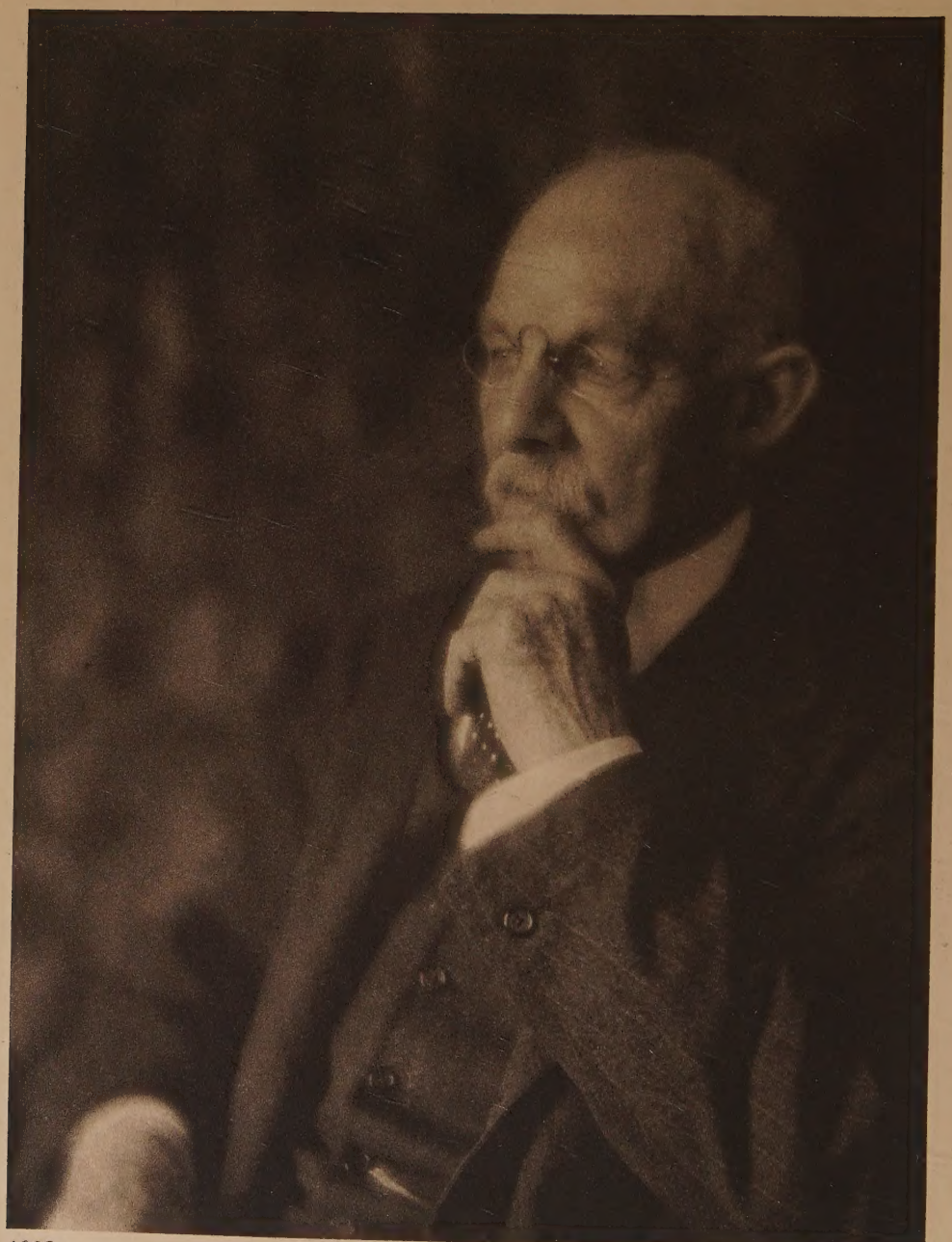

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W. S. Halsted

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WILLIAM STEWART HALSTED

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CANCER OF THE BREAST

THE RESULTS OF OPERATIONS FOR THE CURE OF CANCER OF THE BREAST PERFORMED AT THE JOHNS HOPKINS HOSPITAL FROM JUNE, 1889, TO JANUARY, 1894[1]

In 50 cases operated upon by what we call the complete method, we have been able to trace only three local recurrences.

Local recurrence is a return of the disease in the field of operation—in the apparent or buried scar. The more extensive, therefore, the operation the more liberal our interpretation of local recurrence. Until it became the custom to remove in every case the contents of the axilla, a local recurrence was understood to be a return of the cancer in the apparent scar; but now that we regularly clean out the infraclavicular and usually the supraclavicular region and remove a part, at least, of the pectoralis major muscle, a return of the disease in any part of the explored regions should be considered a local recurrence. As *regionary recurrence* Billroth designated a return of the cancer in or about the scar "after a long time." Recurrences after so long a time[2] he regarded as growths *de novo* and as absolutely independent of the original growth. To explain these late recurrences he assumes a cancer diathesis, or that conditions favorable to the development of cancer have been furnished by the scar.

The great frequency of these late local recurrences and the comparative infrequency of cancer of both breasts makes one hesitate to accept Billroth's explanation of what he terms regionary recurrence. However this may be—and I shall revert to the subject later on—I prefer to reserve the term regionary recurrence for the skin metastases at a greater or less distance from the scar. When operating for cancer of the breast we cannot be responsible for undiscoverable metastases in the skin. For the principal growth, the axilla, the pectoral muscles and the supraclavicular region, in other words for the scar in its fullest sense, we should hold ourselves responsible; but for the eradication of the so-called lenticular and apparently discrete metastases of the skin we have no guide. One might literally flay the patient's

[1] Presented before the Clinical Society of Maryland, Baltimore, April 20, 1894. See page 87, vol. I, for Dr. Halsted's first description of his complete operation for cancer of the breast.

John Hopkins Hosp. Rep., Balt., 1894-95, iv, 297-350. (Reprinted.)

Also: Ann. Surg., Phila., 1894, xx, 497-555. (Reprinted.)

[2] The exact time he does not state, but he is inclined to regard a local recurrence after one and one-half year's freedom from the disease as an independent new growth.

chest and side only to find, a few weeks or months later, one or more cancer nodules in the skin of the neck or back or abdomen.

These lenticular skin metastases or regionary recurrences furthermore distinguish themselves from local recurrences in that they are believed to have formed against the lymphatic current and to have no connection either with the parent tumor or with each other.

Thanks to the most persistent efforts of my house-surgeon, Dr. Joseph C. Bloodgood, the result of the operation has been ascertained in all but two cases. The two unheard-from cases were classed at the time of the operation with the most favorable ones. Only those who have tried it can know what an amount of labor it represents to have traced in this country, and in this part of it, the subsequent histories of such a large percentage of so many cases.

Only one of the three local recurrences was inoperable. In one, suspicious granulations excised one month after the operation were on microscopical examination pronounced carcinomatous. The patient is now perfectly well, without local or regionary recurrence, 2 years and 3 months after the second operation. The third case developed internal metastases prior to the local recurrence, which latter appeared 2 years after the operation.

In eight cases there has been regionary recurrence (*vid.* Tables I and II). Four of these cases are living and four are dead. Of the dead, one, No. 13 (cancer of both breasts), had an inoperable recurrence. Two, Nos. 4 and 12, were operated upon successfully so far as the regionary recurrence was concerned. The fourth case, No. 9, developed cancer of the pleura prior to the regionary recurrence, which latter did not appear until 2 years and 4 months after the operation. This is the only case of recurrence in the supraclavicular glands. It is classed as a regionary recurrence because, being one of the earlier cases, the supraclavicular region was not explored. Hereafter we shall consider supraclavicular recurrences as local, for we now think it advisable to explore and clean out the supraclavicular region in almost every operable case. Of the four living (*vid.* Table II), three, Nos. 35, 40 and 46, have been operated upon for their regionary recurrences and are now well and without recurrence 1 year and 3 months, 11 months, and 3 months respectively after the second operation. One case, No. 41, has operable skin metastases, but has an inoperable carcinoma of the femur.

So far as local and regionary recurrence is concerned the result is known in all but five cases. In 34 (73 per cent) of these there has never been a local or regionary recurrence. Twenty-four are living and 10 are dead. In 43 of the 46 cases (93 per cent) there has been no true local recurrence. In other words, there has, as I have said, been a local recurrence in only three cases (6 per cent). These statistics are so remarkably good that we are encour-

aged to hope for a much brighter, if not a very bright, future for operations for cancer of the breast.

The prognosis at the time of the operation was recorded as hopeless or unfavorable in 27 of the 50 cases of complete operation. In every one of the 50 cases some or all of the axillary glands were cancerous. It is stated in the histories of 17 cases that the highest infraclavicular gland was involved. In only seven cases is it recorded that the highest glands were not involved. In half of the cases, unfortunately, the historian has neglected to give precise information as to the extent of the involvement of the axillary glands. The supraclavicular glands were cancerous in at least five (10 per cent) of the cases.

The pectoral muscles may be involved and the prognosis still be good. Volkmann, many years ago, noted the great difference, prognostically, between involvement of the muscle by simple extension of the growth and invasion of the muscle by metastases.

It is probable, as Ludwig says, that cellular elements, when they have once entered the lymphatic vascular system of a muscle, are soon swept along in the lymphatic current by the muscle activity. Hence the extension of the carcinoma into the muscle acquires an accentuated significance. For it is possible that the cancer cells may at any moment be carried with startling rapidity from one end of the muscle to the other. Fortunately the muscle itself is not usually invaded. In Schmidt's report of 226 cases operated upon by Küster, the tumor was adherent to the underlying parts in only 22 cases. Not one of these cases was cured. But the muscle may be involved when the tumor is not adherent.

In cases of muscle involvement Volkmann has had the best results. But at the time of Sprengel's report only three cases in 36 were living, and one of these had internal metastases. I am not quite prepared to announce positively in what proportion of cases we have found the muscle to be involved, but hope to do so in the second part of this paper which will be devoted chiefly to the consideration of the microscopical work. I can say this, however, that the muscle is less frequently involved than I at one time was led to believe from the microscopical examination of what I now regard as an unusual series of cases.[3]

[3] In one winter it was my fortune to have three very small cancers of the breast to examine. They were so small that I could mount sections of the entire tumor on the ordinary German form of object-carrier. Two of these cancers had already invaded the muscle. The third had advanced to the muscle, but had been stopped by the pectoral fascia. Six years ago I exhibited before the Clinical Society of Maryland a section of one of these tumors. On this occasion I read a paper before the Society on the cure of breast cancer, and advocated the operation which I have since performed with such gratifying results.

Many years ago Volkmann offered an explanation for the fact that the carcinoma may lie in masses on the muscle and be adherent to its fascia and still not involve the muscle itself. He believed that the lymphatic vessels spread themselves out in the fascia covering the pectoralis major muscle and do not follow the blood vessels into the connective tissue septa between the muscle bundles, that there is not as a rule a free communication between the lymphatic system of the muscle and that of the fascia covering it. Haidenhain's observations support this theory of Volkmann's, and it is further strengthened, as Haidenhain says, by the physiological investigations of Ludwig and Schweigger-Seidel on the lymphatic vessels of fascia and tendon. These investigators have established the fact that there is an intricate network of lymphatic vessels on the surface of muscle and on the upper side of all fascias. The direction of the lymphatic current is from the muscle to the fascia, and not in the reverse direction. Injections pass readily in the former, but are impossible in the latter direction. So convinced was Volkmann of the accuracy of his observations and of the truth of his theory that he prescribed a method of operating which he followed until his death, and which has been adopted by almost every good surgeon up to the present time. In his Beiträge zur Chirurgie, Volkmann wrote as follows: "I make it a rule never to do a partial amputation for cancer of the breast, but remove the entire breast even for the smallest tumors, and at the same time I take away a liberal piece of skin. The skin defect is, of course, very great when one operates in this manner, and the wound, in consequence, requires a long time for healing. Furthermore, in making the lower incision I cut right down to the pectoralis muscle and clean its fibres, as I would for a class-room dissection, carrying the knife parallel with the muscular fasciculi and penetrating into their interstices. The fascia of the muscle is, accordingly, entirely removed. I was led to adopt this procedure because, on microscopical examination, I repeatedly found when I had not expected it that the fascia was already carcinomatous, whereas the muscle was certainly not involved. In such cases a thick layer of apparently healthy fat separated the carcinoma from the pectoral muscle, and yet the cancerous growth, in places demonstrable only with the microscope, had shot its roots along the fibrous septa down between the fat lobules and had reached and spread itself out in flat islands in the fascia. It seems to me, therefore, that the fascia serves for a time as a barrier, and is able to bring to a halt the spreading growth of the carcinoma." I quote Volkmann at such length because his operation is a classical one. His observations were accurate, and they have been confirmed in almost every detail by Haidenhain.

With reference to the involvement of the fat, which in greater or less quantity separates the breast from the pectoral muscle, Haidenhain says:

"I am firmly convinced from what I have seen that carcinomata when they have actually made their way into the lymphatic channels, and such is usually the case, have invariably sent their outposts [*Vorposten*] at once to the surface of the muscle, no matter what the thickness of the layer of fat between breast and muscle may have been; in other words, that a tumor, however freely movable on the underlying parts, has almost certainly advanced as far as the surface of the muscle." The latter remains, as Volkmann has already observed, entirely healthy for a long time, and this is certainly no less remarkable. In only three of the 18 cases placed by Küster at Haidenhain's disposition was the muscle invaded by the cancer.

A glance at the tables which I have made from the records of Bergmann, Billroth, Czerny, Fischer, Güssenbauer, König, Küster, Lücke and Volkmann should convince one that the operation for the cure of breast cancer, as practised by the surgeons who have labored the most successfully for the mastery of the disease, is still a very imperfect one.

These tables have been made to determine the percentage of local recurrences after the operation for the cure of breast cancer. I am personally responsible for them, and publish them in full in order that authors who may be surprised at their own results may readily test the accuracy of my figures. The efficiency of an operation is measured truer in terms of local recurrence than of ultimate cure. For some lives are rescued only by repeated operations for local recurrence, and others, free from local recurrence, are lost from internal metastases.

Cures which have been effected by one operation should be distinguished from those which are the result of several operations; and deaths without local recurrence from those with such recurrence. I wish that it had been practicable to separate the true local from the regionary recurrences in all of the tables. But the descriptions of the recurrences are sometimes so vague ("Recidiv," "Wiederum, von Carcinom befallen," "Am Ende der Narbe nach dem Sternum zu") that I have not done so. Furthermore, the local recurrences are so greatly in excess of the regionary recurrences (of the latter alone there are very few) that it did not seem worth while to attempt to make this distinction.

Bergmann had local recurrence in at least 51 per cent, and not improbably in 60 per cent of 114 cases operated upon between the autumn of 1882 and May, 1887. I venture to say *not improbably,* because of 19 patients nothing is known except that they are dead. Eight patients whom I have tabulated as having no local recurrence survived the operation only seven and a half months (average time p. o.). Six cases died in from nine days to two months after the operation.

Billroth had local recurrences in 85 per cent of 170 cases, from 1867 to 1876. *Vide* Table IV.

Czerny, in 62 per cent of 102 cases, from 1877 to 1886. *Vide* Table V.

Fischer, in 75 per cent of 147 cases, from 1871 to 1878. *Vide* Table VI.

Güssenbauer, in 64 per cent of 154 cases, from 1878 to 1886. *Vide* Table VII.

König, in from 58 to 62 per cent of 152 cases, from 1875 to 1885. *Vide* Table VIII.

Küster, in 60 per cent of 228 cases, from May, 1871, to December, 1885. *Vide* Table IX.

Lücke, in 66 per cent of 110 cases, from 1881 to 1890. *Vide* Table X.

Volkmann, in 59 per cent of 131 cases, from 1874 to 1878. *Vide* Table XI.

I believe that this is a fair exposition of the best work that has been done in the treatment of cancer of the breast. Many of these cases were operated upon before it had become a universal rule to systematically clean out the axilla. But each of the distinguished surgeons whose results I have tabulated recognized the fact that the axillary glands were usually involved, even when they could not be felt, and had made for himself a rule to explore the axilla in almost every case. Volkmann (Sprengel) and Güssenbauer were perhaps the first to suggest that it might be well to explore the axilla in every case, but Küster was the first to advocate the systematic cleaning out of the axilla.

Every one knows how dreadful the results were before the cleaning out of the axilla became recognized as an essential part of the operation. Most of us have heard our teachers in surgery admit that they have never cured a case of cancer of the breast. The younger Gross did not save one case in his first hundred. Hayes Agnew stated in a lecture a very short time before his death that he operated on breast cancers solely for the moral effect on the patients, that he believed the operation shortened rather than prolonged life. H. B. Sands once said to me that he could not boast of having cured more than a single case, and in this case a microscopical examination of the tumor had not been made. There are undoubtedly many surgeons still in active practice who have never cured a cancer of the breast. But occasional cures of breast cancer have in all times been observed by reliable surgeons. C. v. Siebold removed the breast and subsequently the contents of the axilla for cancer, and for many years after the second operation had opportunities to see his patient and to convince himself that there was no recurrence of the disease.

Nélaton reports several permanent cures after operation for breast cancer. Velpeau, from 187 women operated upon for breast cancer, knew of seven who had lived for from 5 to 20 years after the operation.

Pauli excised first one breast and then the other for cancer and saw his patient 18 years later.

Encouraged by these rare but positive cures, German surgeons led by Volkmann have for many years been earnestly at work on this problem. But no positive advance in the pathology of breast cancer and no essential improvement in the operation for its cure has been made since Volkmann's contribution in 1875. Indeed, with one or two uncertain exceptions, there have been no results better than his so far as local recurrence is concerned.

As to ultimate results—permanent cures effected by the operation—we again look to Volkmann and accept, as every one does, but with some modifications, his views as to what shall be called a radical cure. I must quote again the lines which have so often been quoted: "I unhesitatingly make this statement for all cancers, that when a whole year has passed and the most careful examination can detect neither a local recurrence nor swollen glands, nor any symptoms of internal disease, one may begin to hope that a permanent cure may be effected; but after two years usually, and after three years almost without exception, one may feel sure of the result."[4]

Billroth[5] thought that Volkmann expressed himself too cautiously and said: "I think that one may express himself more boldly and may declare that if the careful examination of an experienced surgeon detects no recurrence when one year has passed since the operation, one may be sure that there will be neither a local nor glandular recurrence and may pronounce the patient as radically cured." Volkmann prophesied truer, for recurrences after one year are very common. Most surgeons have accepted Volkmann's views and do not consider the disease as radically cured unless three years have passed since the operation. The best results after three years are as follows:

Bergmann (Eichel), 30.2 per cent; Billroth (v. Winnivarter), 4.7 per cent; Fischer (Henry), 9 per cent; Güssenbauer (Fink), 16.7 per cent; König (Hildebrand), 22.5 per cent; Küster (Schmidt), 21.5 per cent; Lücke (Dietrich), 16.2 per cent; Volkmann (Sprengel), 14 per cent.

Volkmann's statistics seem to have some bearing on the question as to the advisability of removing in all cases the pectoralis major muscle. He excised the pectoralis major and with it sometimes the minor in 38 cases. These were his worst cases, cases in which one or both muscles were involved. They were sometimes hopeless and always more or less desperate. In only 11 of these cases was there recurrence in the scar; in seven there was regionary recurrence, and in 13 there was neither local nor regionary

[4] *Loc. cit.*, p. 325.

[5] Billroth: Krankheiten der weiblichen Brustdrüse. Handbuch der Chirurgie. Billroth & Lücke.

and then reflected inwards in order to liberate or prepare for the reflection upwards of this part of the minor muscle.

10. The upper, outer portion of the minor muscle is drawn upward (*vid.* Plate L) with a broad sharp retractor. This liberates the retractor which until now has been holding back the clavicular portion of the pectoralis major muscle.

11. The small blood vessels (chiefly veins) under the minor muscle near its insertion must be separated from the muscle with the greatest care. These are imbedded in loose connective tissue which seems to be rich in lymphatics and contains more or less fat. This fat is often infiltrated with cancer. These blood vessels should be dissected out very clean and immediately ligated close to the axillary vein. The ligation of these very delicate vessels should not be postponed, for the clamps occluding them might of their own weight drop off or accidentally be pulled off; or the vessels themselves might be torn away by the clamps. Furthermore, the clamps, so many of them, if left on the veins, would be in the way of the operator.

12. Having exposed the subclavian vein at the highest possible subclavicular point, the contents of the axilla are dissected away with scrupulous care, also with the sharpest possible knife. The glands and fat should not be pulled out with the fingers, as advised, I am sorry to say, in modern textbooks and as practised very often by operators. The axillary vein should be stripped absolutely clean. Not a particle of extraneous tissue should be included in the ligatures which are applied to the branches, sometimes very minute, of the axillary vessels. In liberating the vein from the tissues to be removed it is best to push the vein away from the tissues rather than, holding the vein, to push the tissues away from it. It may not always be necessary to expose the artery, but I think that it is well to do this. For sometimes, not usually, the tissue above the large vessels is infiltrated. And we should not trust our eyes and fingers to decide this point. It is best to err on the safe side and to remove in all cases the loose tissue above the vessels and about the axillary plexus of nerves.

13. Having cleaned the vessels, we may proceed more rapidly to strip the axillary contents from the inner wall of the axilla—the lateral wall of the thorax. We must grasp the mass to be removed firmly with the left hand and pull it outwards and slightly upwards with sufficient force to put on the stretch the delicate fascia which still binds it to the chest. This fascia is cut away close to the ribs and serratus magnus muscle.

14. When we have reached the junction of the posterior and lateral walls of the axilla, or a little sooner, an assistant takes hold of the triangular flap of skin and draws it outward, to assist in spreading out the tissues which lie on the subscapularis, teres major and latissimus dorsi muscles. The opera-

tor having taken a different hold of the tumor, cleans from within outwards the posterior wall of the axilla. Proceeding in this way, we make easy and bloodless a part of the operation which used to be troublesome and bloody. The subscapular vessels become nicely exposed and caught before they are divided. The subscapular nerves may or may not be removed, at the discretion of the operator. Küster lays great stress upon the importance of these nerves for the subsequent usefulness of the arm. We have not as yet decided this point to our entire satisfaction, but I think that they may often be spared to the patient with safety.

15. Having passed these nerves, the operator has only to turn the mass back into its natural position and to sever its connection with the body of the patient by a stroke of the knife from *b* to *c*, repeating the first cut through the skin.

All that has been removed is in one piece (*vid.* Plates L, LI, and LII). There are no small pieces nor shreds of tissue. I believe that we should never cut through cancerous tissues, when operating, if it is possible to avoid doing so. The wound might become infected with cancer either by the knife which has passed through diseased tissue and perhaps carries everywhere the cancer-producing agents, or by the simple liberation of the cancer cells from their alveoli or from the lymphatic vessels. The division of one lymphatic vessel and the liberation of one cell may be enough to start a new cancer.

This may explain some or all of the very late (from 3 to 5 or even more years) local recurrences which are not rarely met with. It is a more plausible theory, I think, than that offered by Billroth, of a cancer diathesis and that conditions favorable to the development *de novo* of cancer are furnished by the scar. If the explanation which I suggest is the correct one, we should expect to find these very late recurrences somewhere in the field of operation rather than as lenticular metastases in the skin. And such is really the case. I have found thus far no positive instance of recurrence as late as three years which was not in the scar in its broad sense. Of 15 cases of recurrence after three years, not one is reported as having taken place primarily in the skin. One case (Güssenbauer, case 71), the only one which might be construed as a late recurrence in the skin, was already an inoperable cancer *en cuirasse* when observed by the surgeon 3 years after the operation, and may have been an early and not a late recurrence.

Another argument in favor of this theory of inoculation is the following: When carcinomata have once begun to grow rapidly they continue to do so. The pace, if I may use the term, increases rather than decreases as the growth advances. The metastases of rapidly growing carcinomata also increase rapidly in size; they seem to take the pace of the parent growth, although this is not invariably the case. We can readily understand why

there should be exceptions to this rule. The metastasized cells may have the full virulence of the home cells, but may not at once find the conditions so favorable for their development.

The early local recurrence is probably always an uninterrupted growth so far as place is concerned, a direct continuation of the parent growth or its metastases. It makes its appearance very soon after the operation, and grows as fast as, or faster than it was growing at the time of the operation. The lenticular metastases in the skin may appear in great numbers in a very short time, but the individual nodule grows slowly and seldom attains a large size. The skin seems to offer a certain resistance to the growth of the cancer. Whether it does or does not offer this resistance, might we not expect to find these so-called late recurrences, occasionally at least, in the skin if they are always continuous growths? Consulting again our tables, we find that primary recurrences in the skin rarely, if ever, make their appearance as late as one year after the operation.

The operation, as we perform it, is literally an almost bloodless one. From the first to the last each bleeding point is stopped with an artery forceps as quickly as possible. When practicable the vessels are clamped before they are divided. If no blood is lost there is no perceptible shock from the operation. This is true of almost every operation. The symptoms which are so often ascribed to shock are due almost invariably to loss of blood. I have performed this operation for breast cancer on patients whose pulse before the operation was so feeble that the anaesthetizer and bystanders have pronounced it barely perceptible. As a rule the pulse is little if any feebler after the operation than it was before it.

The edges of the wound are approximated by a buried, purse-string suture of strong silk. Of the triangular flap of skin (*abc*) only the base is included in this suture. The rest of this flap is used as a lining for the fornix of the axilla. The apex of this flap is consequently shifted to a new and lower position. The axilla is never drained and invariably heals by first intention. The uncovered wound often heals by the so-called organization of the blood clot.

Seventy-six operations (complete and incomplete) for breast cancer have been performed in the hospital, and not one death has resulted from the operation.

Twenty-six incomplete operations have been performed. Seven were incomplete because of the small size and recent appearance of the tumor. Four of these are living, one with a local recurrence. Two died with metastases—one, and perhaps both, with local recurrence.[6]

[6] The seven incomplete operations probably furnished as many (3) local recurrences as the 50 complete operations.

Nineteen operations were incomplete because of the magnitude of the growth and the hopelessness of the case. These operations were undertaken for the moral effect upon the patient, and were usually little more than an ablation of the greater part of the new growth.

As to the disability produced by the operation, it has in some cases been so slight as to be absolutely inappreciable. In most cases the arm of the side operated upon has been quite as useful as before the operation. Some of the patients when questioned complain that they cannot dress their back hair. This disability is due to the loss of skin and not to the loss of muscle. The cicatrix sometimes prevents the patient from raising the arm high enough to dress the back of the head. We have twice relieved this trouble by skin grafting. In no case that I know of has the disability of which the patient complained been due to the excision of the muscle or muscles. Occasionally there has been temporary swelling of the extremity.

If we permitted the arm to become glued to the side—and this would often happen if we did nothing to prevent it—there would be disability from fixation. We are careful, therefore, to secure a high axillary fornix. This is accomplished by means of the triangular flap of skin (*abc*) which is devoted almost entirely to this purpose, and which is held in place by a carefully applied dressing. After all, disability, ever so great, is a matter of very little importance as compared with the life of the patient.

Furthermore, these patients are old. Their average age is nearly 55 years. They are no longer very active members of society. We should, perhaps, sacrifice many lives if we were to consider the disability which might result from removing a little more tissue here and there.

I sometimes ask physicians who regularly consult us why they never send us cancers of the breast. They reply, as a rule, that they see many such cases but supposed that they were incurable. We rarely meet a physician or surgeon who can testify to a single instance of positive cure of breast cancer. The conscientious physician could not under the circumstances advise his patient to be operated upon, and he was justified in treating her with salves and internal remedies. But now we can state positively that cancer of the breast is a curable disease if operated upon properly and in time. I cannot emphasize too strongly the fact that internal metastases occur very early in cancer of the breast, and this is an additional reason for not losing a day in discussing the propriety of an operation.

Surgeons should practise this operation on the cadaver. It is not an operation that can be properly performed after two or three trials. We operate for cancer of the breast better now than we did last year, and we operated better last year than five years ago. I have not had a local recurrence for more than three years.

Now that surgery is specialized to such an extent, surgeons have plenty of time to drill themselves in operating. They should not cast about for easy operations—for operations that any one can do at any time and in any place. I think that surgeons will some day contemplate with astonishment some of the handy, happy-go-lucky methods for intestinal suture which are now so much in vogue.

Case 1[7] (Surgical No. 12).—L. S., aet. 38. Married. Ten children. Menstruation on decline. Tumor of left breast for six months. Pain in breast and arm for two or three months. The tumor now occupies the entire breast and is adherent to the pectoral muscle. The nipple is retracted. There is a large abscess in the axilla.—28, 5, 1889, abscess in axilla opened.—14, 6, breast and part of the major pectoral muscle excised; axilla not cleaned out at this time because of suppurating wound.—21, 7, excision of scar, remainder of pectoral muscle and axillary contents, which latter were very adherent to vessels. The glands of the axilla were carcinomatous. Very unfavorable case. Discharged in two weeks; wound healing well.—5, 11, 1889, granulating area excised and grafted with skin. No local nor regionary recurrence when last observed, one year after first operation. Lived about 1½ years. Died of cancer of the other breast.

Case 2 (Surg. No. 177).—M. J. J., aet. 39. Married. Eight children. Menstruation more profuse and frequent since appearance of tumor. Cancer of left breast for five months. Growth has been very rapid during the last four weeks. Pain for four months in the affected breast. Now the pain is also in the axilla, shoulder and arm.—15, 10, 1889, complete operation. Favorable case. Discharged in five weeks with healthy granulating wound. Lived three years and three months. Cause of death unknown. Written report says no recurrence.

Case 3 (Surg. No. 326).—M. A., aet. 63. Married. One child. Menopause at thirty-five. Tumor of left breast observed for four years. Began, says patient, one year after an injury. Five years ago noticed oozing of blood from left nipple, which continued for one year. Nipple then began to retract and a nodule appeared at its outer side. The pains, shooting in character, are sharp, but not constant. The tumor is hard and involves the nipple and the skin surrounding it. It moves freely on the pectoral muscle. The supraclavicular glands have been enlarged for the last two weeks.—21, 2, 1890, complete operation. Glands in axilla were small, carcinomatous and very hard, but not adherent to the vessels. Regarded as favorable case. Discharged in three weeks with healthy granulating wound. Result unknown. Patient cannot be found.

Case 4 (Surg. No. 360).—E. S., aet. 53. Married. Ten children. Menopause three years ago. Tumor, size of orange, of left breast for eleven months, attributed to injury. Began as small, hard lump in outer hemisphere. Pain for past week only. It resembles the pain of a needle prick.

[7] I wish to express again my thanks to Dr. Bloodgood for the following abstract of the histories.

The nipple is not retracted. Skin not adherent. Tumor freely movable over muscle. Axillary glands cannot be felt.—11, 3, 1890, complete operation. Glands in axilla hard and small, but not adherent to the vessels. Considered favorable case. Patient discharged in two weeks with healthy granulating wound.—6, 7, 1892 (two years and four months after the operation), regionary recurrence. A small nodule in skin on the outer side of the scar; also enlarged supraclavicular glands. Second operation. Glands and nodule excised. Wound healed in three weeks. No local nor regionary recurrence.—1, 3, 1894, reported dead.

Case 5 (Surg. No. 385).—M. A., aet. 27. Married. Two children. One miscarriage. Menstruation normal. Has lost flesh of late. Cancer of the left breast for nine months. Began as nodule in outer hemisphere. Rapid growth and much pain in breast and arm for past two months. The nipple is involved but not retracted. Pressure on breast expresses a rusty-colored fluid from nipple. Axillary glands enlarged.—21, 3, 1890, complete and satisfactory operation. Favorable case. Discharged in four weeks with healthy granulating wound. Died three years and seven months after operation; cause of death unknown.

Case 6 (Surg. No. 388).—S. C. D., aet. 60. Widowed. Menopause at 47. Two children. One miscarriage. Has pulmonary tuberculosis. Two and one-half years ago first noticed an enlargement of outer half of left breast. A few months later the nipple became sore. A few months ago enlarged glands were noticed in the axilla. Since then has had much pain.—27, 3, 1890, operation as complete as possible. Glands not very large, but matted together and so adherent to the vessels and other parts that a clean dissection was almost impossible. Discharged in four and one-half weeks with healthy granulating wound. Died in two years and seven months of internal metastasis. Letter from friends does not mention local return.

Case 7 (Surg. No. 624).—F. A. W., aet. 53. Married six years. Childless. Menopause one year ago. General health good. Tumor of the right breast for four months, following an injury. Cancer the size of hen's egg in the outer and upper quadrant of right breast. It is freely movable on underlying parts and not adherent to skin. The nipple is retracted. A few small hard glands are to be felt in the axilla.—6, 9, 1890, complete operation. Glands in axilla are imbedded in large amount of apparently healthy fat. Prognosis very favorable. Discharged in three weeks with healthy granulating wound.—10, 11, 1890, wound is healed.—March, 1894 (three years and seven months after operation), patient enjoys best of health. No signs of recurrence. Small painless cicatrix. There is no swelling of the arm and patient has good use of it.

Case 8 (Surg. No. 650).—K. B., aet. 39. Married 12 years. One child. Menstruation regular. Tumor of left breast for three months. Cyst size of hen's egg in upper and inner quadrant of left breast, 4 cm. to left of sternum. It is freely movable under skin on underlying parts. Nipple not retracted. Axillary glands not palpable.—2, 10, 1890, cyst excised. On microscopical examination the walls of the cyst proved to be carcinomatous.—11, 10, 1890, complete operation. Patient discharged in two weeks with healthy

granulating wound.—March, 1894 (three years and six months after operation), patient in excellent health, no signs of recurrence. Good use of arm.

Case 9 (Surg. No. 691).—V. U., aet. 40. Married. Six children. Menstruation normal. General health good. Tumor of left breast for three months, appearing, says patient, two days after an injury. When first observed was the size of a hickory nut. Growth has been gradual and without pain. Cancer the size of a walnut, freely movable on underlying parts. Skin not adherent. Nipple not retracted.—10, 31, 90, complete operation except for supraclavicular glands. Glands below clavicle involved. Prognosis almost absolutely bad.—18, 11, 1890, granulations excised and skin grafted to hasten healing. Discharged in five weeks with wound entirely healed.—April, 1892, well. No return in scar or axilla, but supraclavicular glands enlarged.—March, 1893 (two years and five months after operation), patient in excellent health and spirits.—15, 3, 1893, shortness of breath.—July, 1893, signs of carcinoma of left lung and pleura; arm and shoulder swollen. Skin nodules over right breast and in right axilla. No return in scar nor left axilla.—January, 1894, three years and two months after operation, died from internal metastasis. No local recurrence.

Case 10 (Surg. No. 758).—P. H., aet. 35. Negress. Married 17 years. Fourteen children. Menstruation normal. Abscess in right breast during first lactation. General condition good. Tumor of right breast for nine months. Cancer now occupies entire breast. Nipple is retracted. Large glands in axilla.—12, 12, 1890, complete operation. Highest axillary and supraclavicular glands involved. Prognosis hopeless. Discharged in four and one-half weeks with healthy wound. Died with symptoms of internal metastasis in seven months. Neither local nor regionary recurrence.

Case 11 (Surg. No. 821).—Mrs. C., aet. 66. Widowed. Maternal aunt died with cancer of the breast. Abscess in left breast with first lactation. Five months ago noticed pain in left breast, and then a tumor. Has now a cancer the size of a walnut in the upper and outer quadrant of the left breast. It is freely movable on the underlying muscle. Nipple slightly retracted. Skin not adherent. Axillary glands slightly enlarged.—27, 1, 1891, complete operation. Only a few enlarged glands in the axilla. Prognosis at operation favorable. Discharged in seven weeks with healthy granulating wound.—6, 7, 1891, five months after the operation, local recurrence. Small nodule at edge of scar of left breast. Fullness and diffuse induration in right breast, but no glands to be felt in the right axilla. Operation. Excision of a portion of the right breast for examination. Pathological report: nodule from scar carcinoma. Piece from right breast normal.—17, 2, 1892 (one year and one month after the first operation), diffuse recurrence in scar of left breast. Carcinoma of stomach. Sugar in urine. Excision of the recurrence attempted. Disease found to involve several of the ribs. Died of carcinoma of stomach in about one and one-half years after first operation.

Case 12 (Surg. No. 978).—M. Z., aet. 62. Married. Eight children. General health not good. Somewhat emaciated. Four years ago noticed three "pimples" under left nipple, which enlarged and ulcerated one year ago. Cancer now occupies center of left breast. Nipple ulcerated. Glands

can be felt in axilla.—15, 5, 1891, complete and satisfactory operation. Prognosis favorable. Discharged in four weeks with healthy granulating wound.—20, 10, 1891 (five and one-half months after operation), regionary recurrence. Small nodule in skin on the outer side of scar. No return in scar or axilla. Nodule excised. Reported dead. Cause and time (?) of death unknown. No mention of recurrence.

Case 13 (Surg. No. 1109).—J. J., aet. 35. Married. Menstruating. Cancer of both breasts. One year ago patient detected painless nodule in left breast. She had not noticed the nodule in her right breast. The left breast is uniformly enlarged. Skin is adherent. Nipple retracted. Tumor movable on pectoral muscle. In the right breast is a small nodule. Skin not adherent to it. Nipple not retracted. Glands in both axillae enlarged.—6, 8, 1891, complete and satisfactory operation on left side.—25, 9, 1891, complete operation on right side. Satisfactory dissection. Discharged 15, 11, 1891. No recurrence in wound or axilla, but skin metastasis on both sides of chest.—July, 1892 (eleven months after first operation), numerous metastases in skin of chest. Some ulcerating. General health quite good. No recurrence in scar nor axillae. Four inoculations with pure culture of the streptococcus of erysipelas with negative results.

Case 14 (Surg. No. 1123).—A. W., aet. 59. Colored. Widowed. Thirty years ago patient noticed painless lump in left breast. Two years ago the tumor began to grow perceptibly. Since then patient has had intermittent pain in breast. The cancer is movable on the muscle. Skin adherent. Nipple retracted.—13, 8, 1891, complete operation. Part of pectoralis minor removed. Highest gland in axilla involved. Prognosis unfavorable. No nodules in muscle discoverable by microscope.—March, 1894 (two years and six months), patient in good health. No local nor regionary recurrence.

Case 15 (Surg. No. 1180).—F. H. E., aet. 41. Married. Two children. Two miscarriages. Youngest child ten years old. One year ago lump noticed in upper hemisphere of left breast. Pain during last ten days in breast and left shoulder, three weeks ulcerated. Cancer, ulcerated, size of hen's egg, freely movable on muscle, but adherent to skin. Small glands to be felt in left axilla.—16, 9, 1891, complete operation. Prognosis very unfavorable. Discharged in four weeks. Patient died a few weeks after reaching home. No local nor regionary recurrence.

Case 16 (Surg. No. 1246).—J. J. S., aet. 45. Married. Seven children. Two miscarriages. Menstruation regular. Five years ago noticed small lump below right nipple. Pain for the last three months, intermittent, darting. Cancer below right nipple, size of a marble, tender, freely movable on pectoralis major muscle. Nipple retracted. Skin adherent. Axillary glands not palpable.—22, 10, 1891, complete operation. A few carcinomatous glands in axilla. Prognosis favorable. Microscopical examination. The cancer is a circumscribed one. A few epithelial masses in axillary glands. Patient discharged in four and one-half weeks.—March, 1894 (two years and five months after operation), patient is perfectly well. Has no local nor regionary recurrence.

Case 17 (Surg. No. 1248).—E. McG., aet. 49. Widowed. Seven children. One miscarriage. Menstruation regular. Tumor above nipple of left breast for two years. For one year intermittent pains, ulceration of skin over tumor and retraction of nipple. Cancer 4 x 6 cm. in outer and upper quadrant of left breast. Movable on pectoralis muscle, but adherent to skin. Axillary glands enlarged.—22, 10, 1891, complete operation. Highest axillary gland involved. Nodule the size of a pea in the major pectoral muscle. No local nor regionary recurrence for two years. Then return in scar. Died of internal metastases two years and four months after operation.

Case 18 (Surg. No. 1255).—E. E., aet. 54. Married. Four children. Youngest child twenty-six years old. Menopause four years ago. Five years ago patient noticed tumor of right breast. She attributes it to an injury sustained six years ago. Patient has a cancer in the upper and outer quadrant of the right breast. The nipple is retracted. The axillary glands are enlarged.—27, 10, 1891, complete operation. The highest gland of axilla is involved. Prognosis unfavorable. In four weeks a suspicious spot developed in the wound. This and the surrounding granulations were promptly excised. The microscopical examinations of the suspected granulations proved them to be carcinomatous.—March, 1894 (two years and four months after the operation), patient is very well and has good use of the arm. There is no local nor regionary recurrence.

Case 19 (Surg. No. 1337).—J. E. T., aet. 62. Married. No children. Menopause several years ago. Forty-six years ago noticed small lump in the left breast, which caused no discomfort until two years ago, when it began to grow and to become painful. The entire left breast is now involved, but it is freely movable on the pectoral muscle. In the upper and outer quadrant of the breast is a mass of bony hardness. The axillary glands are palpable.—15, 12, 1891, complete operation. The highest infraclavicular gland was involved. Prognosis unfavorable. On examination of the excised breast a calcified fibroma is found near the outer edge of the tumor. Patient died in twenty-one months without local or regionary recurrence.

Case 20 (Surg. No. 1359).—Aet. 37. Married three years. No pregnancies. Menstruation irregular. Five weeks ago noticed nodule below left nipple. Has sharp intermittent pains. Cancer 2 x 5 cm. below and to inner side of nipple, freely movable on pectoral muscle and not adherent to skin. Nipple not retracted. Axillary glands not palpable.—29, 12, 1891, complete operation. Highest infraclavicular gland enlarged. Prognosis unfavorable. Discharged in two weeks.—March, 1894 (two years and two months after operation), well. No local nor regionary recurrence.

Case 21 (Surg. No. 1393).—M. E. D., aet. 42. Married. Thirteen children. Menstruation regular. Youngest child one year old. Four months ago noticed small, painful lump above left nipple. The pain has steadily increased. The cancer now involves most of the breast; is movable on the pectoral muscle and not adherent to the skin. The nipple is not retracted. One gland can be felt in the axilla.—19, 1, 1892, complete operation. Highest infraclavicular gland involved. Prognosis unfavorable. Microscopical examination. Adeno-carcinoma of breast and microscopic metastases in

glands.—July, 1892 (six months after operation), well.—April 27, 1894, patient presents herself for examination. Is perfectly well. No local nor regionary recurrence. Good use of arm.

Case 22 (Surg. No. 1429).—E. T. O., aet. 60. Widowed. Five children. Three miscarriages. Menopause five years ago. Has had a lump in left breast for forty years which has given her no trouble until five months ago. Then noticed nodules in left axilla and below left breast. Eight weeks ago the latter became ulcerated and the nipple became retracted. Patient has had no pain. Has a cancer the size of a walnut in the outer hemisphere of the left breast. The skin is inflamed and adherent to the tumor. There are regionary metastases in the skin from the nipple to the axilla. The glands of axilla are enlarged.—11, 2, 1892, complete operation. The pectoralis minor muscle was removed. The highest infraclavicular glands were involved and there were cancerous nodules in the pectoralis major muscle. Discharged in four weeks with healthy granulating wound.—June, 1892, necrosed rib excised at bottom of small granulating wound.—August, 1892 (six months after operation), died of internal metastases. No local nor regionary recurrence.

Case 23 (Surg. No. 1532).—S. A. L., aet. 64. Married. Four children. Menopause twelve years ago. One year ago a small lump, accompanied by darting intermittent pains, appeared in the left breast. Nine months ago the nipple became retracted and the pain became great in the axilla. Cancer in outer hemisphere of left breast, size of an egg, hard, movable on muscle and not adherent to skin. A few small hard glands can be felt in the axilla.—1, 4, 1892, complete operation. Highest infraclavicular gland involved. Prognosis unfavorable. Discharged in two weeks.—March, 1894 (one year and eleven months after the operation), well. Almost perfect use of arm. No local nor regionary recurrence.

Case 24 (Surg. No. 1560).—M. F., aet. 42. Married. Menstruation normal. Eighteen months ago, at end of last lactation, had pain in right breast. Then noticed lump under skin. Has cancer now size of an orange, hard, adherent to skin and to pectoral muscle. Nipple retracted. Enlarged glands in axilla.—21, 4, 1892, complete operation. Prognosis hopeless. Died in eleven months. (Local ret. ?)

Case 25 (Surg. No. 1635).—M. C., aet. 56. Widowed. Six children. Eight months ago noticed lump in skin in left axillary line, which ulcerated three months later, following application of caustic. Cancer 12 x 9 cm. Ulcer 6 x 3 cm. Axillary glands enlarged.—31, 5, 1892, complete operation. Prognosis unfavorable. Pectoral muscle not involved.—March, 1894 (one year and ten months after operation), well. No local nor regionary recurrence. Good use of arm, which is somewhat swollen.

Case 26 (Surg. No. 1676).—A. J. A., aet. 54. Widowed. Four months ago noticed tumor size of walnut, just above nipple. Skin is adherent. Nipple retracted. Axillary glands palpable.—21, 6, 1892, complete operation. Prognosis favorable.—March, 1894 (one year and nine months after opera-

tion), well, good use of arm. No swelling of arm. No local nor regionary recurrence.

Case 27 (Surg. No. 1677).—E. McC., aet. 61. Married. A few weeks ago noticed pain and a small lump in left breast. Cancer the size of a pigeon's egg, movable on pectoral muscle, adherent to skin. Nipple retracted. Axillary glands enlarged.—21, 6, 1892, complete operation. Prognosis favorable. Patient not heard from since discharged.

Case 28 (Surg. No. 1710).—L. S., aet. 66. Married. Three weeks ago noticed a small painless nodule in left breast. Has cancer in upper and outer quadrant of left breast. It is hard and adherent to skin, but movable on pectoralis major muscle. The nipple is retracted. The axillary glands are not palpable.—15, 7, 1892, complete operation. Prognosis favorable. The highest infraclavicular glands were cancerous, but very small. The pectoral muscle was not invaded by the cancer.—March, 1894 (one year and seven months after the operation), well. Good use of arm. Chops wood with it. No local nor regionary recurrence.

Case 29 (Surg. No. 1718).—C. B. K., aet. 62. Widowed. One child. Abscesses in both breasts during lactation thirty years ago. Four months ago noticed soreness in left nipple, and a few days later a lump above the nipple. Cancer, now the size of a duck's egg, chiefly below but embracing nipple. Movable on muscle. Nipple retracted and fissured. Bleeds easily. A large mass of glands in the axilla.—16, 7, 1892, complete operation. Prognosis favorable as to local recurrence. Died in ten months from internal metastases. No local nor regionary recurrence.

Case 30 (Surg. No. 1729).—M. S. J., aet. 60. Negress. Widowed. Two children. Menopause twenty years ago. Four months ago noticed shooting pains and tumor in right breast. One month ago the skin ulcerated at the inner side of the nipple. The cancer now occupies the entire breast. It is hard and not freely movable on muscle. There is an excavated ulcer one inch to the inner side of the nipple. Large hard glands to be felt in the axilla.—29, 7, 1892, complete operation. The highest infraclavicular gland is involved. Prognosis very unfavorable.—December, 1893 (one year and five months after operation), well. No local nor regionary recurrence. Good use of arm.

Case 31 (Surg. No. 1736).—J. S., aet. 60. Married. Nine children. Two years ago pain in right breast and shoulder. Breast was swollen for a short time. Pain and swelling disappeared. Three months ago pain began in right axilla. Three weeks ago noticed lump in right breast. Cancer now occupies outer and lower quadrant of right breast. It is ill defined, hard, intimately associated with the gland, movable on the pectoral muscle, and not adherent to the skin. The nipple is slightly retracted. There is a hard mass of glands in the axilla.—5, 8, 1892, complete operation. Highest infraclavicular gland involved. Tumor adherent to the pectoral major muscle.—March, 1894 (one year and seven months after the operation), well. No swelling, and good use of arm. Soft scar. Skin movable on underlying parts. No local nor regionary recurrence.

Case 32 (Surg. No. 1782).—M. E. C., aet. 54. Married. Eight children. Six miscarriages. Menopause five years ago. One year ago noticed a small lump in left breast. Ulceration supervened very soon. Cancer 12 x 13 cm. in upper outer quadrant. A fungoid mass projects from the ulcer.—7, 9, 1892, complete operation. Cancer circumscribed. Remainder of breast and the pectoral muscle normal. Some of the axillary glands show metastases. Prognosis favorable as to local recurrence. Dead in ten months. No local nor regionary recurrence.

Case 33 (Surg. No. 1819).—M. H., aet. 46. Married. One child, ten years old. Menopause five years ago. One year ago noticed nodule size of a pea in the right breast. Growth of tumor has been slow. Five months ago the skin became adherent and discolored. Six weeks ago the skin ulcerated. Has had intermittent pains from the beginning. Cancer 6 cm. in diameter in the upper hemisphere of right breast. It is freely movable on the muscle. Axillary glands not palpable.—23, 9, 1892, complete operation. Axillary glands small, hard and slightly adherent to the vessels. Prognosis unfavorable.—March, 1894 (one year and five months after the operation), no swelling, and good use of arm. Patient works hard. Has no local nor regionary recurrence.

Case 34 (Surg. No. 1835).—M. McA., aet. 50. Married. Three years ago noticed lump near right nipple. Ulceration began four months ago. Cancer now occupies the center of the right breast, below the nipple. There is an ulcerating area at the outer side of the nipple from which projects a fungoid mass. The axillary glands are enlarged.—30, 9, 1892, complete operation. The minor pectoral muscle also removed. Glands very adherent to the vessels. Clean dissection. Prognosis unfavorable. Died in three and one-half months after the operation. No local nor regionary recurrence.

Case 35 (Surg. No. 1875).—E. Z., aet. 69. Married. Four children. Youngest 38 years. Three months ago noticed a small nodule in the left breast. No pain. Rapid growth. Cancer 2 x 3 cm. in upper and outer quadrant of left breast. It is nodular, freely movable on the pectoral muscle, but adherent to the skin. Nipple slightly retracted. A few glands to be felt in the axilla.—27, 10, 1892, complete operation. Highest infraclavicular gland involved. Prognosis unfavorable. Discharged in four weeks.—January, 1894 (thirteen months after the operation), died of internal metastases. No swelling, and good use of arm. No local nor regionary recurrence.

Case 36 (1903).—Aet. 59. Married. Seven children. Eight months ago noticed a small nodule in the left breast. Tumor has grown very little since first noticed. Patient has had very little pain. Cancer in upper and outer quadrant of left breast, adherent to skin. A few small glands to be felt in the axilla.—8, 11, 1892, complete operation. Prognosis favorable. Discharged in four weeks.—January, 1894 (thirteen months after the operation), died of internal metastases. No swelling, and good use of arm. No local nor regionary recurrence.

Case 37. K. A., aet. 34. Married. Two children. Youngest child eight years old. Menstruation regular. Seven months ago patient noticed two small lumps not larger than beans in the upper part of the right breast. The tumors have been enlarging slowly. For the past three months the patient has had sharp intermittent pains in the right breast. There is a small tumor 3 cm. in diameter above the right nipple. The nipple is not retracted and the tumor is freely movable under the skin and on the muscle. One small gland is to be felt in the axilla.—27, 2, 1893, complete operation. The history says that the pectoralis major muscle was divided but not removed. Inasmuch, however, as not a trace of the muscle is to be felt, I conclude that the historian must have made a mistake and that the operation was a complete one.—3, 5, 1894, patient presents herself for examination. She is perfectly well and has good use of the right arm. There is no local nor regionary recurrence, one year and two months after the operation.

Case 38 (Surg. No. 2070).—L. B., aet. 46. Two years ago noticed small nodule in the right breast. Slow growth. Pains moderate and intermittent for the last six months. Cancer in the upper hemisphere of the right breast the size of a pigeon's egg. It is hard, nodular, freely movable on the pectoral muscle and not adherent to the skin. Nipple retracted. A few small hard glands to be felt in the axilla.—21, 2, 1892, complete operation. Prognosis favorable. Discharged in five weeks with healthy granulating wound.—March, 1894 (one year after the operation), well. Good use and no swelling of arm. No local nor regionary recurrence.

Case 39 (Surg. No. 2107).—M. Y., aet. 46. Married. Seventeen years ago noticed very hard lump in the right breast. At first there were shooting and intermittent pains. There are none now. Retraction of the nipple began three months ago. Cancer of the right breast occupies half of the outer hemisphere. It is movable on the pectoral muscle, but very adherent to the skin. Nipple retracted. Very large glands to be felt in the axilla.—16, 3, 1893, complete operation. The highest infraclavicular glands are involved. Prognosis unfavorable. Discharged in five weeks.—March, 1894 (one year after the operation), well. No swelling, and good use of arm. No local nor regionary recurrence.

Case 40 (Surg. No. 2166).—S. C. S., aet. 43. Married. Five years ago noticed a small lump in left breast which was painful on pressure. For two years the growth was very slow. For the last year the growth has been very rapid. A severe pain extends down the arm. For the last few months has not been able to lift the arm. Cancer now occupies the entire left breast. It is attached to the pectoral muscle and is adherent to the skin. The nipple is retracted. Glands to be felt in the axilla.—15, 4, 1893, complete operation. The highest infraclavicular gland is involved. Prognosis unfavorable. Discharged in four weeks.—29, 11, 1893 (seven months after operation), regionary recurrence. Enlarged supraclavicular glands; also skin metastases at the outer side of scar. No local recurrence. Glands and skin nodules excised.—March, 1894, well. No local nor regionary recurrence.

Case 41 (Surg. No. 2256).—Mrs. O., aet. 46. Widowed. One child. Menstruating. Four years ago noticed lump in left breast. The growth has

been rapid for the last two years. Nipple became retracted eighteen months ago. Glands to be felt in axilla. Large cancer in outer hemisphere of left breast.—22, 5, 1893, complete operation. Supraclavicular glands. The highest infraclavicular gland involved. Prognosis unfavorable. Discharged in seven weeks.—September, 1893, complains of pain in the left hip and walks with cane. Readmitted with fracture of femur, probably caused by bone metastases.—16, 12, 1893 (seven months after operation), skin metastasis noticed at the outer side of scar. Three in skin over shoulder.—March, 1894, the skin metastases have enlarged very little and have increased in number. The enlargement of the femur continues. There is no return in scar, axilla or supraclavicular region. No local recurrence. The regionary recurrence is easily operable. Operation contraindicated by cancer of femur.

Case 42 (Surg. No. 2339).—M. P., aet. 65. Widowed. Seven children. Eleven months ago noticed lump in the left breast. Pain has been present for six months. Small cancer in upper and outer quadrant of left breast. Skin not involved. Nipple not retracted. One small gland to be felt in the axilla. Patient says it has been there for fifteen years.—8, 9, 1893, complete operation. The highest infraclavicular gland is not involved. The breast nodule is circumscribed. The remainder of the gland and muscle apparently uninvolved. There are microscopic metastases in the axillary glands.—March, 1894 (seven months after the operation), well. No local nor regionary recurrence.

Case 43 (Surg. No. 2517).—A. S., aet. 44. Single. Two years ago noticed lump outside of right nipple. Retraction of nipple observed three months ago. Continuous pain from beginning. Cancer 5 x 3 cm. in the outer and upper quadrant of right breast. Adherent to nipple and to skin near nipple. Movable on the muscle. A few glands to be felt in the axilla.—6, 10, 1893, complete operation. The highest infraclavicular gland not involved. Prognosis favorable.—March, 1894 (four and one-half months after the operation), no local nor regionary recurrence.[8]

Case 44 (Surg. No. 2565).—S. G., aet. 60. Married. Ten children. Five years ago injured right breast. Three months later a small lump appeared in the upper part of this breast. Severe pain extended to the shoulder and down the right arm. The cancerous nodule is at the outer border of the breast over the pectoral muscle. It is adherent to both skin and muscle. The nipple and remainder of breast apparently uninvolved. A few small glands can be felt in the axilla.—20, 10, 1893, complete operation. The pectoralis minor muscle also removed. Prognosis unfavorable because of the infiltration of both pectoral muscles.—March, 1894 (three months after the operation), well. No local nor regionary recurrence.

Case 45 (Surg. No. 2594).—P. B., aet. 40. Colored. Widowed. Three children. Five months ago noticed small lump in the left breast. Pain at

[8] April 4th, 1894. Recurrence in scar and axilla 6 months after operation.—7, 4, 1894, operation for recurrence. The axillary recurrence was in a gland near the apex of the axilla and adherent to the axillary vein. Neither operation was performed by me.

first, but none now. Cancer 5 x 5 cm. in upper and outer quadrant of left breast. Freely movable on muscle. A few small glands to be felt in the axilla.—2, 11, 1893, complete operation. Highest infraclavicular gland involved. Prognosis unfavorable. Cancerous nodule invades the fascia of the pectoralis muscle.—March 15, 1894 (three and one-half months after operation), well. No local nor regionary recurrence.

Case 46 (Surg. No. 2614).—M. T., aet. 29. Married. One child. Child four months old. Tumor of right breast, noticed two months ago. This breast gives more milk than the other. Cystic tumor occupies the upper and inner quadrant of the right breast, which is painful and tender. The tumor cannot be outlined from the remainder of the gland. Skin and nipple apparently normal. Axillary glands not palpable.—11, 11, 1893, operation. Incision into cyst filled with cheesy serum, resembling sero-pus. Piece of the wall excised for examination found to be malignant cystic-adenoma.—17, 11, 1893, complete operation. Pectoral muscle and axillary glands show no metastasis.—6, 12, 1893, small lenticular nodule in skin at lower and outer side of scar. Nodule excised.—March, 1894, no local nor further regionary recurrence.

Case 47 (Surg. No. 2628).—P. S., aet. 64, male. Twenty years ago injury to breast. Has been tender and painful ever since this injury. Fifteen years ago noticed nodule near left nipple. Has now a cancer about 2½ cm. in diameter in the inner and upper quadrant of the left breast. Nipple, skin and pectoralis major muscle are involved.—16, 11, 1893, complete operation. Highest infraclavicular gland not involved. Prognosis favorable. Microscopical examination. Cancer is circumscribed, but invades pectoral fascia and muscle. The axillary glands show metastasis. Tissue from apex of axilla normal.—March, 1894 (three and one-half months after operation), well. No local nor regionary recurrence.

Case 48 (Surg. No. 2654).—S. M. D., aet. 43. Married. No children. Ten months ago noticed tumor of left breast. Pain and discomfort for first four months. Has now a small, hard cancerous nodule in the inner and upper quadrant of the left breast. Breast is movable on muscle. Skin slightly adherent. Nipple not retracted. Numerous miliary skin metastases surrounding nipple. A few palpable glands in axilla and above clavicle.—20, 11, 1893, complete operation. Highest infraclavicular gland not involved. Prognosis favorable.—March, 1894 (three months after operation), well. No local nor regionary recurrence.

Case 49 (Surg. No. 2739).—J. R., aet. 33. Single. Menstruation normal. One year ago attention drawn to tumor by a rusty-colored serous discharge from right nipple. Pain, which began one month ago, now radiates to the right shoulder. Small tumor of inner and upper quadrant of right breast. It is nodular, freely movable on muscle and not adherent to skin. Nipple slightly, if at all, retracted. Axillary glands not palpable.—12, 9, 1893, operation. Excision of a cyst with suspicious wall. Microscopical examination of the wall. Cystic-adenoma. Intracystic papillomatous growths. Here and there earliest stages of carcinoma.—2, 2, 1894, complete operation. Prognosis is most favorable. Only one cancerous gland found in the axilla.—

March 20, 1894 (two months after the operation), no recurrence. This patient has also a myoma of the uterus.

Case 50 (Surg. No. 2791).—E. B., aet. 54. Married. Two children. Carcinoma of the cervix uteri removed by vaginal hysterectomy, six months ago. Tumor of left breast, noticed four weeks ago. Darting pains. Cancer in outer hemisphere, size of a hen's egg. Freely movable on muscle. Very hard and nodular. Not adherent to skin. Nipple slightly retracted. One small, hard gland to be felt in the axilla.—2, 2, 1894, complete operation. Prognosis very favorable. Highest infraclavicular gland not involved.—March 20, 1894, no local nor regionary recurrence.

TABLE II.—WM. S. HALSTED, JOHNS HOPKINS HOSPITAL, 1889-94.

Special No.	Surgical No.	Local recurrence
11	821	Scar. 5 months p. o. 2d recurrence hopeless. Died carc. ventriculi 1½ years.
17	1248	Scar. 2 years p. o. Nodule in pect. major at 1st op. Died 2 year 4 months internal metastases.
18	1255	Scar. 1 month p. o. Excised successfully. Well. No recurrence 2 years 4 months p. o.

Special No.	Surgical No.	Regionary recurrence
4	360	Skin and supraclav. gl 2⅓ years p. o. Excised successfully. 4 years p. o. reported dead.
9	691	Supraclavicular glands. Lenticular metastases in skin over opposite breast and in opposite axilla 2 years 4 months. † 3 years and 2 months p. o.
12	978	One small nodule in skin outer side of scar 5½ months p. o. Excised, presumably successfully. Dead. No local nor regionary recurrence reported.
13	1109	Cancer both breasts. Multiple skin nodules 1½ months. 1 year p. o. no local recurrence.
35	1875	Nodule under skin 6 months. Excised. Well. No recurrence 1 year 3 months.
40	2166	Skin nodules outside of scar 7 months p. o. Excised. Well. No recurrence 18 months p. o., 11 months after 2d operation.
41	2256	Operable skin nodules outer side of scar 7 months p. o. Living. Carc. femur.
46	2614	Nodule in skin lower and outer side of scar 3 months p. o. Excised. Well. No recurrence 3 months after 2d operation.

50 CASES. LOCAL RECURRENCE, 6 PER CENT

No local recurrence						Results as to local recurrence unknown			Cases unheard from		
Special No.	Surgical No.	Living	Special No.	Surgical No.	Lived	Special No.	Surgical No.		Special No.	Surgical No.	
7	624	3 yrs. 7 mos. p. o.	1	12	1½ years.	5	385	† 3 yrs. 7 mos.	3	326	Favorable case.
8	650	3 yrs. 6 mos.	2	177	3 yrs. 6 mos.	6	388	† 2 yrs. 7 mos.	27	1677	Favorable case.
14	1123	2½ years.	10	758	7 months.	24	1560	† 11 months.			
16	1246	2 yrs. 5 mos.	15	1180	2 months.						
20	1359	2 yrs. 2 mos.	19	1337	1 year 9 mos.						
21	1393	2 yrs. 2 mos.	22	1429	6 months.						
23	1532	1 yr. 11 mos.	29	1718	10 months.						
25	1635	1 yr. 10 mos.	32	1782	10 months.						
26	1676	1 yr. 9 mos.	34	1835	3½ months.						
28	1710	1 yr. 7 mos.	36	1903	13 months.						
30	1729	1 yr. 7 mos.									
31	1736	1 yr. 7 mos.									
33	1819	1 yr. 5 mos.									
37	2064	1 yr. 2 mos.									
38	2070	1 year.									
39	2107	1 year.									
42	2439	7 months.									
43	2517	4½ months.									
44	2565	3½ months.									
45	2594	3½ months.									
47	2628	3½ months.									
48	2654	3 months.									
49	2739	2 months.									
50	2791	2 months.									

TABLE III.—BERGMANN (EICHEL),[9] 1882-87. 114 CASES.

Local recurrence			Died soon after the operation		
No.	Situation	Time p. o.	No.	Cause of death	Time p. o.
35	Scar, axilla, infra and supraclav. gl.		51	Carc. liver and lungs.	2 months.
36	(1) Recurrence supraclav. (2) Recurrence.	Both soon after operation.	56	Carc. pleura.	2 months.
			85	Cause unknown.	2 months.
37	Scar in neck, infra & supraclav. gl.	1 year 6 months.	106	Cause unknown.	9 days.
38	Scar and axilla.	10 months.	107	Ulcers ventriculi.	11 days.
39	Supraclav. and scar.	3 "	108	Pleuritis, suppurative.	14 days.
40	Supraclav.	9 "	109	Cause unknown.	28 days.
	Scar.	9 "	110	Cause unknown.	23 days.
41	Scar, supraclav.	4 "			
42	Scar.	3 "			
43	Axilla, scar, right and left supraclav. glands.	1 month.			
44	" Local recurrence."	Soon after discharge.			
46	Scar, supraclav.	Soon after discharge.			
59	Scar.	1 year.			
60	Scar, supraclav.	9 months.			
62	Scar.	6 "			
64	Scar.	Immediately.			
66	" Local recurrence."	1 month.			
67	" Local recurrence." Supraclav. gl.	6 months.			
69	Scar and supraclav. glands.	4 "			
70	Scar.	10 "			
71	Scar.	18 "			
72	Scar.	3½ "			
74	Scar and axilla.	6 months after operation.			
75	Scar, axilla and supraclav. glands.	2 months.			
77	Scar.	1 month.			
79	Scar.	9 months.			
80	" Local recurrence."	9 "			
82	Scar.	5 "			
84	Skin near scar.	2 "			
87	Scar.	Soon after operation.			
88	Axilla.	7 months.			
91	Scar and supraclav. glands.	Soon after operation.			
92	Scar.	17 months after op.			
93	Scar.	5 months.			
95	Scar.	18 months.			
96	Scar, axilla and supraclav. glands.	Soon after operation.			
97	" Local recurrence," also supraclav. glands.	Few weeks after operation.			
99	Scar, infraclav.	5 weeks.			
101	Scar.	Soon after operation.			
102	Scar.	3 months.			
103	Scar.	Few weeks after op.			
104	Scar.	Very soon after op.			
94	" Local and regionary recurrence."				
98	" Local and regionary recurrence."				
45	" Recidiv."	4 months.			
105	Scar and supraclav. glands.				

[9] Ueber die in der von Bergmann'schen Klinik von Herbst 1882 bis Mai 1887 operirten primären Fälle von Brustkrebs. Inaug. Diss. Berlin, 1887.

LOCAL RECURRENCE, FROM 51 TO 60 PER CENT

No local recurrence		Result as to local recurrence unknown		Result unknown
No.	Time p. o.	No.	Time p. o.	
1	4 years 9 months.	61	† Less than 1 year.	111
2	4 years 1 month.	63	†	112
3	4 years 2 months.	65	†	113
4	4 years 2 months.	73	† 1 year 2 months.	114
5	4 years.	50	† 5 months.	
6	3 years 10 months.	54	† 6 months.	
7	3 years 9 months.	68	† 2½ years.	
8	3 years 6 months.	76	†	
9	3 years 9 months.	78	†	
10	3 years 3 months.	81	†	
11	3 years 1 month.	86	†	
12	3 years 2 months.	90	†	
13	2 years 10 months.	83	†	
14	2 years 10 months.	89	†	
15	2 years 7 months.	100	†	
16	2 years 2 months.			
17	2 years.			
18	1 year 11 months.			
19	1 year 3 months.			
20	1 year 2 months.			
21	1 year 1 month.			
22	11 months.			
23	1 year 5 months.			
24	11 months.			
25	6 months.			
26	6 "			
27	6 "			
28	6 "			
29	7 "			
30	3 "			
31	3 "			
32	2 "			
33	2 "			
34	3 years 6 months.			
47	† 9 months.			
49	† 8 "			
53	† 6 "			
58	† 4 "			
48	† 11 "			
55	† 4 "			
52	† 1 year 2 months.			
57	† 5 months.			

TABLE IV.—BILLROTH (A. v. WINNIWARTER),[10] 1867-76. 170 CASES.

	Local recurrence	
No.	Situation	Time p. o.
34	Scar.	Immediately.
62	Skin near scar.	2 days.
63	Scar.	Very soon.
64	Miliary nodules near scar.	1 month.
65	Axilla.	1 month.
66	"Local recurrence."	?
67	"Local recurrence."	About one year.
68	(1) Middle of scar.	6½ months.
	(2) Axilla.	1 year.
69	Scar and granulating wound.	Very soon.
70	Skin near scar.	Very soon.
71	Scar.	2 months.
72	(1) Scar.	4 months.
	(2)	10 months.
73	Scar.	
74	Supraclav. glands.	?
75	"Local recurrence."	?
76	Skin and axilla.	?
77	Near scar.	2 months.
78	"Local recurrence."	Soon after discharge.
79	Near scar.	Soon after healing.
80	Near scar.	Soon after healing.
81	Infraclav. glands.	2 months.
82	Skin some distance from scar.	Before complete healing.
83	In scar.	Soon after healing.
84	"Local recurrence."	Soon after discharge.
86	Near scar.	2 years.
87	Scar and axilla.	3½ years. ?
88	Supraclav. glands.	Soon after healing.
89	Near scar.	Very soon.
90	Skin, pectoral muscle and axilla.	During healing.
92	(1) Near scar.	1 year.
	(2) Axilla.	3½ years. ?
93	Granulating wound.	
94	"Local recurrence."	?
95	Near scar.	1½ years.
97	Near scar.	Soon after discharge.
98	"Local recurrence."	Very soon.
99	Axilla and edge scar.	Few months.
100	Infraclav. glands.	Very soon.
101	Near scar and axilla.	Soon after discharge.
102	(1) Near scar and axilla.	Soon after discharge.
	(2)	Soon after second operation.
103	Near scar.	Soon after discharge.

[10] Beiträge zur Statistik der Carcinome. Stuttgart, 1876.

LOCAL RECURRENCE, 82 PER CENT

	Local recurrence	
No.	Situation	Time p. o.
104	Axilla and near scar.	Four weeks after discharge.
106	Axilla and near scar, below scar.	Soon after operation.
107	Scar.	Soon after healing.
108	Scar.	Soon after discharge.
109	(1) Scar.	18 months.
	(2) Axilla.	13 Months.
110	Scar.	Soon after healing.
111	Near wound before healing.	
112	Scar.	8 months.
113	Breast during healing.	
114	Scar.	9 months.
115	Axilla below scar.	1½ months.
116	Skin and axilla.	Soon after healing.
117	Axilla near scar.	Soon after healing.
119	(1) Axilla.	16 months.
	(2) Scar.	22 months.
122	(1) Near scar.	About 3 years.
	(2) In scar and skin.	6 months later.
124	Axilla.	Immediately.
	(2) Lower edge of pectoral muscle.	4¾ years.
125	(1) Skin, supraclav. and infraclav. gl. and axilla.	About 3 years.
	(2) Skin and axilla.	6 years.
130	Axilla not extirpated.	Immediately.
131	Axilla and infraclav. glands.	Immediately.
132	Scar and axilla.	13 months.
133	Scar and lower edge of pectoral muscle.	1 year.
136	(1) Skin.	3 months.
	(2) Scar and axilla.	5 years.
137	Scar.	Few months.
138	Axilla.	1 year.
141	(1) Scar, axilla, infra. and supraclav. glands.	1 year.
	(2) Scar, infra. and supraclav. glands.	1½ years.
	(3) Scar and near axilla.	2 years.
143	Scar.	3 months.
146	Breast and axilla.	3 months.
148	Scar and axilla.	7 months.
153	Scar.	1 year.
155	(1) Scar.	2 years.
	(2) Axilla.	4 years.
159	(1) "Local recurrence."	Immediately.
	(2) Breast.	6 years.
164	(1) Scar.	1 month.
	(2) Scar and axilla.	3 months.
165	(1) Above scar.	4 months.
	(2) Scar.	5 months.

TABLE IV.—CONTINUED

Died soon after the operation			No local recurrence		Result unknown
No.	Cause of death	Time p. o.	No.	Time p. o.	No.
28	Septicaemia.	10 days.	120	3 years.	91
29	Pyaemia.	37 days.	154	5 years 9 months.	118
30	Pyaemia.	22 days.	156	3 years 3 months.	121
31	Pyaemia.	12 days.	157	6 years 1 month.	123
32	Pyaemia.	11 days.	158	3 years 8 months.	126
33	Erysipelas.	16 days.	160	2 years 2 months.	127
35	Septicaemia.	3 days.	162	2 years 1 month.	128
36	Pyaemia.	8 days.	163	3 years 5 months.	129
37	Septicaemia.	Day of operation.	167	2 years.	134
38	Erysipelas.	11 days.	168	1 year 1 month.	135
39	Septicaemia.	7 days.	169	5½ months.	139
40	Erysipelas.	12 days.	166	3½ months.	142
41	Erysipelas.	32 days.	170	4 years 3 months.	144
42	Pyaemia.	16 days.	140	† 1 year 11 months.	145
43	Pyaemia.	11 days.	161	† 1 year.	147
44	Erysipelas.	12 days.			148
45	Septicaemia.	14 days.			150
L.	Peritonitis.	13 days.			151
47	Erysipelas.	7 days.			
48	Haemorrhage axilla artery.	7 days.			
49	Erysipelas.	41 days.			
50	Septicaemia.	2 days.			
51	Erysipelas.	7 days.			
52	Erysipelas.	39 days.			
53	Erysipelas and pneumonia.	12 days.			
54	Erysipelas.	10 days.			
55	Erysipelas.	37 days.			
56	Erysipelas.	28 days.			
57	Marasmus following erysipelas.	63 days.			
58	Erysipelas.	16 days.			
59	Haemorrhage axilla artery.	6 days.			
60	Pleuritis.	1 day.			
61	Erysipelas.	8 days.			
152	Acute "internal disease."	Soon after discharge.			

TABLE V.—CZERNY (G. B. SCHMIDT),[11] 1877-86. 102 CASES.

Local recurrence			Died soon after the operation		
No.	Situation	Time p. o.	No.	Cause of death	Time p. o.
1	Scar.	3 months.	6	Erysipelas.	18 days.
3	Scar.	5½ years.	26	Erysipelas.	11 days.
5	Scar.	8 months.	44	Erysipelas.	13 days.
7	Scar.	3 months.	45	Iodoform poisoning.	23 days.
8	Axilla.	4 years.			
9	Suture holes, skin, muscle, supraclav. gl.	4 months.			
10	Scar, supraclav. glands.	1 month.			
11	Lenticular recurrence of entire side.	6 months.			
17	Scar, supraclav. and cervical glands.	2 years.			
18	Scar.	3 months.			
20	Scar and axilla.	2 months.			
21	Axilla.	1 year.			
	Scar.	1⅔ years.			
29	Scar and axilla.	3¾ years.			
31	Scar and axilla.	3 months.			
33	Axilla and pect. muscle.	3 months.			
	Scar.	3 years.			
34	Scar.	4 months.			
35	Scar.	7 months.			
36	Scar and axilla.	3 months.			
38	Lenticular recurrence about scar.	8½ months.			
43	Scar.	3½ months.			
	Axilla.	1 year.			
46	Axilla.	2½ years.			
48	Scar and axilla.	1 year.			
50	Axilla.	11 months.			
53	Scar.	5 months.			
	Axilla.	Later.			
61	Scar.	1 month.			
64	Scar.	5 months.			
68	Scar.	7 months.			
72	Scar.	2 months.			
74	Scar.	1 month.			
83	Scar.	6 weeks.			
86	Scar and axilla.	1⅓ years.			
88	Scar and axilla.	4½ months.			
91	Lenticular in skin.	2 months.			
92	Above scar.	3 months.			
96	Lenticular recurrence about scar.	8(?) months.			
99	Scar.	6 months.			
102	Scar.	2 months.			
	Axilla.	7 months.			

[11] Die Geschwülste der Brustdrüse. Beiträge zur klinischen Chirurgie, Bd. IV, 1889.

LOCAL RECURRENCE, 64 PER CENT

No local recurrence		No note as to local recurrence			Result unknown
No.	Time p. o.	No.	Cause of death	Time p. o.	No.
2	9½ years.	13	Enlarged axillary glands not removed at operation.		4
15	† 1¾ years.			†	12
16	† 1 year.	25		† 1 year.	14
22	7 years.	47		† 1 year 9 months.	19
23	† 3 years.	51	Carc. ventriculi.	† 11 months.	27
24	† 7 years.	52		† 4 months.	28
32	7 years 2 months.	54		† 1 year.	30
40	† 5½ months.	55	Carc. other breast.	† 1 year.	37
49	5 years 7 months.	57		† 6 or 8 months.	39
70	4 years 3 months.	59		† 3 months.	41
77	3 years 10 months.	60		† 2 years.	56
79	1 year 10 months.	66		† 3 months.	58
80	4 years 5 months.	73		† 6 months.	62
81	† 4 months.	75		† 10 months.	63
84	4 (?) years.	76		† 7 months.	65
89	1 year 8 months.	78		† 1½ years.	67
90	1 years 8 months.	94		† 7 months.	69
93	1 year 7 months.	98	Pleuritis.	† Less than 1 year.	71
97	1 year 1 month.				82
100	2 (?) years.				85
109	2 (?) years.				87
					98

TABLE VI.—ARTHUR HENRY[12] (H. FISCHER). INAUG. DISS. BRESLAU, 1879. LOCAL RECURRENCE, 75 PER CENT

Local recurrence			Died from the operation, or too soon to exclude local recurrence			No local recurrence		Result unknown
No.	Situation	Time after operation	No.	Cause of death	Time after operation	No.		No.
15	Scar.	9 months.	109	Exhaustion.	Few weeks.	1	8¾ years.	111
19	Scar and axilla.	15 months.	118	General carcinosis.	4 weeks.	2	7¾ years.	114
26	Scar.		119	Pyaemia.	1 week.	3	7 years.	115
29	"Recurrence" probable.	18 months.	120	Croupous pneumonia.	1 month.	4	6 years.	116
30	Scar and axilla.		121	Anaemia.	1 month.	5	6 years.	117
31	Scar.	28 months.	122	Septicaemia.	8 days.	6	5 years.	
32	Scar.	8 months.	123	Pyaemia.	1 month.	7	4½ years.	
33	Scar and supraclav. glands.	12 months.	124	Acute peritonitis.	15 days.	8	4½ years.	
34	Scar.	18 months.	125	Pyaemia.	8 days.	9	3¾ years.	
35	Scar and axilla.	7 months.	126	Erysipelas.	18 days.	10	3¾ years.	
36	Scar.	11 months.	127		A few weeks.	11	3¾ years.	
37	Scar and skin.	18 months.	128	Oedema of the lungs.	4 days.	12	3¼ years.	
38	Scar and axilla.	3 months.	129	Septicaemia.	2 days.	13	2½ years.	
39	Scar	12 months.	130	Pleuritis.	34 days.	14	2¼ years.	
40	Scar, neck and skin		131	Inanition.	2 months.	16	1¾ years.	
41	(1) Skin and axilla.	18 months.	132	Septicaemia.	8 days.	17	1½ years.	
	(2) Scar.	6 months.	133	Pyaemia.	A few days.	18	1½ years.	
42	Scar.		134	Pyaemia.	22 days.	20	1 year.	
43	Scar.		135	Septicaemia.	10 days.	21	1 year.	
44	Scar and skin.	9 months.	136	Erysipelas.	12 days.	22	1 year.	
45	"Recurrence."	3 months.	137	Erysipelas.	4 days.	23	9 months.	
46	Axilla, skin and under pectoral muscle.	5 months.	138	Pyaemia.	18 days.	24	1 year.	
47	Scar and sternum.	30 months.	139	Septicaemia.	6 days.	25	9 months.	
48	"Recurrence."		140	Gangrene.	6 days.	27	4 years.	
49	Scar.	18 months.	141	Erysipelas.	4 weeks.	28	6 months.	
50	"Recurrence."	3 months.	142	Erysipelas.	40 days.	107	6 months.	
51	Scar.	6 months.	143	Diphtheria.	2 weeks.	113	2 years.	
52	Scar.	9 months.	144	Septicaemia.	4 weeks.			
53	Scar.	6 months.	145	Apoplexy.	9 days.			
54	Scar.	6 months.	146	Fatty heart.	48 days.			
55	Scar.	3 years.	147	Meningitis.	3 weeks.			
56	"Recurrence."							
57	"Recurrence."							
58	"Recurrence."							
59	Axilla.	Less than one year.						
60	"Recurrence."	3 months.						
61	"Recurrence."	6 months.						
62	Axilla.							
63	Scar.	9 months.						
64	"Recurrence."	6 months.						

65	"Recurrence."	6 months.
66	"Recurrence."	
67	"Recurrence."	12 months.
68	Axilla.	28 months.
69	"Recurrence."	
70	Scar.	3 months.
71	Scar.	Few weeks.
72	"Recurrence."	
73	"Recurrence."	6 months.
74	Skin.	9 months.
75	Scar.	3 months.
76	"Recurrence."	6 months.
77	Supraclav. glands.	6 weeks.
78	Scar.	3 months.
79	Scar.	6 months.
80	Scar.	Few weeks.
81	Skin.	6 months.
82	"Recurrence."	3 months.
83	Scar.	
84	Axilla and supraclav. glands.	9 months.
85	Scar.	2 months.
86	Scar.	12 months.
87	Scar.	9 months.
88	"Recurrence."	6 months.
89	"Recurrence."	6 months.
90	"Recurrence."	6 months.
91	Scar.	Few weeks.
92	Scar and axilla.	12 months.
93	Scar and axilla.	6 months.
94	Scar.	3 months.
95	Axilla.	15 months.
96	"Recurrence."	12 months.
97	Scar and axilla.	3 months.
98	"Recurrence."	3 months.
99	Scar and axilla.	Few weeks.
100	Scar.	3 months.
101	Scar.	3 months.
102	Scar.	2 months.
103	Skin.	6 months.
104	Scar and axilla.	6 months.
105	"Recurrence."	
106	Scar.	Few weeks.
108	Scar and axilla.	3 months or less.
110	Scar.	9 months or less.
112	Scar and axilla.	8 months or less.

[12] Statistische Mittheilungen über den Brustkrebs, 1871-78. 147 Cases.

TABLE VII.—DR. FRANZ FINK (GUSSENBAUER). PRAG. ZEITSCHRIFT FUR HEILKUNDE, 1888.[13] LOCAL RECURRENCE, 64 PER CENT

Local recurrence			Died soon after the operation local recurrence			No note as to local recurrence			No local recurrence		Result unknown
No.	Situation	Time p. o.	No.	Cause of death	Time p. o.	No.		Time p. o.	No.	Time p. o.	No.
38	Scar two places.	10 months.	33	Sepsis and pneumonia.	1 month.	54	† Carc. lungs and vetebrae.	1 year.	68	† 2 years.	176
39	Scar.	2 months.	34	Pneumonia.	21 days.	59	† Carc. sternum.	1 year.	92	† 1 year.	179
40	Recurrence.	12 months.	35	Died on operating table.		75	† Carc. venticuli.	18 months.	94	† 1¾ years.	180
41	Scar.	7 months.	36	Erysipelas.	3 weeks.	77	† Carc. ventriculi.	2 years.	96	† 6 months.	181
42	Recurrence.	?	37	Erysipelas.	Few days.	99	† Carc. ventriculi.	6 months.	98	† 4 months.	183
43	Scar.	32 months.	111	Metastases.	1 month.	107	†	11 months.	114	† 14 months.	184
44	Scar and axilla.	Immediately.				112	†	5 months.	121	† 9 months.	185
45	Scar, axilla and neck.	12 months.				113	† Cachexia.	3 months.	126	† 1 year.	
46	Scar.	32 months.				120	† Carc. ventriculi.	4 months.	135	9½ years.	
47	Axilla.	3 months.				123	† Carc. pleurae.	5 months.	136	8 years 9 months.	
48	Scar and axilla.	Immediately.				128	† Carc. liver, and possibly stomach.		137	7 years 2 months.	
49	Axilla and skin.	?							138	6 years 9 months.	
50	Recurrence.	?							139	6 years 7½ months.	
51	Scar and axilla.	4 months.							140	5 years 9⅜ months.	
52	Scar and axilla.	6 weeks.							141	5 years 7 months.	
53	Scar.	3½ months.							142	5 years 6 months.	
55	Supraclav. glands and skin.	Few months.							143	5 years 5½ months.	
56	Scar.	?							144	5 years 15 days.	
57	Axilla and supraclav.	8 months.							145	3 years 10 months.	
58	Scar and axilla.	6 months.							146	3 years 10 months.	
60	Recurrence.								147	3 years 8 months.	
61	Scar and axilla.	9 months.							148	3 years 10 months.	
62	Recurrence.	6 months.							150	3 years 10 months.	
63	Scar.	16 months.							151	3 years 30 (?) months.	
64	Scar.	Immediately.							152	3 years 2 months.	
65	Skin.	10 months.							153	3 years 4 months.	
66	Scar.	?							154	3 years 3 months.	
67	Recurrence.	?							155	2 years 5 months.	
69	Scar.	4 weeks.							156	2 years 1 month.	
70	Scar.	?							157	2 years 1 month.	
71	Inoperable cancer *en cuirasse*.	3 years.							158	1 year 8 months.	
72	Scar.	2 years.							159	1 year 7 months.	
73	Scar.	1½ years.							160	1 year 6 months.	
74	Scar.	5 months.							161	1 year 6 months.	
76	Scar.	Few weeks.							162	1 year.	
78	"Recurrence."	?							166	† 4 years 7 months.	
79	Scar and axilla.	4 years.							167	† 7 years 4½ months.	
80	Scar and axilla.	Immediately.							168	† 3 years 11 months.	
81	Scar.	Very soon.							169	† 3 years 4½ months.	
82	Scar.	4 months.							170	† 1 year 6 months.	

83	Scar.	10 months.
84	Scar.	Immediately.
85	Scar.	11 months.
86	Scar.	3 years.
87	Middle of scar.	22 months.
88	Scar.	3 months.
89	Scar.	4 weeks.
90	Scar.	6 months.
91	Scar, axilla and supraclav.	8 months.
93	Scar.	Immediately.
95	Scar.	Very soon.
97	"Recurrence."	
100	Scar and axilla.	Very soon.
101	Scar.	Very soon.
102	Scar and axilla.	3½ months.
103	Scar.	3 months.
104	Scar.	12 months.
105	Scar.	3 months.
106	"Recurrence."	11 months.
108	Scar.	Very soon.
109	Scar.	Immediately.
110	Scar.	Very soon.
115	Scar and axilla.	15 months.
116	Scar.	3 weeks.
117	Scar.	Very soon.
118	Scar.	Very soon.
119	Scar and axilla.	Very soon.
122	Axilla.	Very soon.
124	Scar and axilla.	4 weeks.
125	Scar.	
127	Scar and axilla.	6 weeks.
129	Scar.	12 months.
130	Scar and axilla.	Very soon.
131	Scar.	Very soon.
132	Scar and axilla.	Very soon.
133	Scar and axilla.	?
134	Scar, axilla & supraclav. glands.	?
149	Scar.	14 months.
163	Scar.	4½ months.
164	Scar.	8 months.
165	Supraclav.	
177	Scar and axilla.	9 months.
182	Scar.	Immediately.
171	† 2 years 4 months.	
172	† 1 year 1½ months.	
173	† 1 year 1½ months.	
174	† 2½ years.	
175	† 3 years.	
178	† 9 years.	

TABLE VIII.—KONIG (HILDEBRAND),[14] 1875-85. 152 CASES. LOCAL RECURRENCE FROM 58 TO 62 PER CENT

Local recurrence			Died soon after the operation			No local recurrence		No.	Result unknown
No.	Situation	Time p. o.	No.	Cause of death	Time p. o.	No.	Time p. o.		
1	Skin.	4 weeks.	5	Erysipelas.	10 days.	3	11 years.	21	Carc. vertebrae, died less than one year.
2	Skin and axilla.	3 months.	10	"Abdominal disease."	51 days.	4	1½ years.	28	General carcinosis.
7	Axilla.	1½ years.	13	Apoplexy.	50 days.	6	1¾ years.	35	Result unknown.
11	Axilla and skin.	After 3 years.	15	Erysipelas.	12 days.	8	13 months.	58	(?)
18	Axilla.	3 years.	16	Septicaemia.	8 days.	9	13 months.	64	† 1 year.
22	Scar.	2 years.	19	(?)	Few days.	12	4 years.	95	† 18 months. (?)
24	Scar, "cuirasse."	2 months.	20	Haemorrhagic living infarction.	2 days.	14	6 years.	121	(?)
25	Scar.	1 year.	29	Septicaemia.	9 days.	17	9 years.	122	(?)
27	"Cuirasse."	3 months.	33	Pneumonia.	16 days.	23	3 years.	130	† 1 year.
30	Scar.	3 or 4 months. (?)	61	Erysipelas and pneumonia.	8 days.	26	6 years.	131	† 6 months. Carc. liver.
36	Scar.	6 months or less.	69	Drowned.	2 months.	31	6 years.	134	(?)
37	Scar.	8 months.	74	Broncho-pneumonia.	11 days.	40	7 years.	138	(?)
38	Axilla.	16 months.	76	Pneumonia.	9 days.	41	6 years.	139	† 1 year. Carc. liver.
39	Axilla.	1 month.	98	Erysipelas.	6 days.	44	6 years.		
42	(?) Recurrence.	8 months.	91	Pneumonia, cancer of lungs and bronchi.	19 days.	45	3 years.		
43	Scar and above clav.	3 years.				46	6 years.		
47	Axilla.	1 year.				49	6 years.		
48	"Recurrence."	6 months.				54	6 years.		
50	Axilla and scar.	11 months.				62	† 17 months.		
51	Scar.	Never healed.				80	4 years.		
52	"Local recurrence."	2 or 3 months.				83	4 years.		
53	Axilla.	5 months.				84	3 years.		
55	Scar and axilla.	Immediately.				86	4 years.		
56	Scar.	2 months.				87	4 years.		
57	Above scar.	Immediately.				90	3 years.		
58	Axilla and above clavicle.	† 2 years or less.				97	1 year.		
60	Scar. (?)	Immediately.				105	2¾ years.		
63	"Recurrence."	† 1 year.				108	† 1½ years. Cancer of kidney.		
65	Scar.	† 1 year.				110	2 years.		
66	Scar.	4 months.				113	3 years.		
67	"Recurrence."	6 months.				114	2 years.		
68	"Recurrence," sternum pect muscle.	(?) years.				116	† Less than 1 year. Suicide.		
70	Scar never healed.	† 3½ months.				117	2 years.		
71	Scar and axilla.	13 months.				118	2 years.		
72	Scar and skin. (?)	† 8 months.				119	2 years.		
73	Scar.	Immediately.				123	6 months.		
75	Skin and axilla.					124	† 1 year.		
77	Scar.	1 year.				128	1¼ years.		
78	"Recurrence."	† 6 months.							

81	Scar and axilla.	6 months.
	Scar (?) and axilla.	14 months.
82	"Recurrence."	6 months.
85	Scar and axilla.	6 months.
89	Axilla.	10 months.
92	Scar.	6 months.
93	Skin.	6 months.
	Scar.	8 months.
94	Scar.	6 months.
	Scar.	10 months.
96	Scar and skin.	2 years.
98	Scar and axilla.	2 years and 7 months.
99	Scar.	† 11 months.
100	Scar.	† 13 months.
101	"Recurrence."	2 months.
103	Scar.	Less than 3 months.
104	Scar.	Less than 1 year.
106	Scar.	† 6 months.
107	Scar.	6 months.
	2d and 3d operations.	† 1 year.
109	Axilla.	2 months.
112	Axilla.	6 months.
115	Scar.	5 months.
120	Skin below and near scar.	9 months.
125	Recurrence scar and above clavicle.	6 months.
126	Scar.	Few weeks.
127	Scar.	5 months.
132	Pect. major near axilla.	1 year.
133	Scar. (?)	4 years.
	Operated four times, still alive.	9 months.
136	Scar and axilla.	† 2 years with recurrence.
140	Scar (?) and axilla.	1 year. (?)
141	Scar.	6 months.
142	Scar.	
143	Scar.	Immediately. (?)
144	Scar.	1 year.
147	Scar.	
	2d operation, alive 3 years after.	3 months.
148	Scar (?) and skin.	1 year.
149	Scar.	
129		1 year.
135		† 2 years.
137		3 years.
145		3 years.
146		3 years.
150		2 years.
151		6 months.
152		6 months.
34		† 1 year.
32		† 6 months.
28		† 6 months.
79		† 6 months.
102		† 6 months.
111		† 5 months.

[14] Beitrag zur Statistik des Mammacarcinoms der Frau. Deutsche Zeitschrift für Chirurgie, Bd. 25, 1887.

TABLE IX.—KUSTER.[15] FROM MAY, 1871-DEC., 1885. 228 CASES. LOCAL RECURRENCE, 59 PER CENT

Local recurrence			Died soon after the operation			No local recurrence		No note as to local recurrence			No.	Result unknown
No.	Situation	Time p. o.	No.	Cause of death	Time p. o.	No.	Time p. o.	No.	Cause of death	Time p. o.		
1	(1) Scar.	8 months.	2	Erysipelas.	13 days.	18	15 years.	37	† Carc. of pleura and stomach.		57	
	(2) Axilla scar.	14 months.	10	Erysipelas.	18 days.	34	8 years.			2 yrs. 5 mos.	65	
3	Axilla.	Soon after healing.	11	Erysipelas.	9 days.	40	3 years.	39	† Carc. of pleura.	3 months.	70	
4	Scar.	Immediately.	25	Pyaemia.	12 days.	42	3 years.	41	† Erysipelas.	5 months.	78	
5	(1) Scar.	Immediately.	28	Erysipelas.	19 days.	43	4 years.	67	† "Recurrence," (pleura ?)	2¾ years.	83	
	(2) Skin of neck.	8 months.	31	Profuse diarrhoea.	5 days.	50	4 years.	69	† "Recurrence" (Carc. vertebral column).	2¼ years.	92	
	(3) Breast and axilla.	11 months.	35	Erysipelas.	10 days.	51	7 years.	72	† "Recurrence" (vertebral column and liver).	(?) 13 mos.	106	
	(4) Near scar, axilla.	13 months.	47	Collapse.	2 days.	55	† 3 years.	84	† "Recurrence" lung cancer.	3½ years.	107	
6	"Recurrence."	Very soon.	53	Pleuritis carcinomatosa.	3 days.	56	7 years.	96	† "Recurrence."	10 months.	131	† Probably recurrence
7	"Local recurrence."	Immediately.	59	Septicaemia.	6 days.	58	6 years.	95	† Carc. of pleura.	1 year.	165	
8	"Local recurrence."	Very soon.	91	Collapse.	3 days.	77	6 years.	95		† 5 years.	168	
9	"Local recurrence."	Immediately.	100	Erysipelas.	16 days.	80	4 months.	102	† Probably metastases.		169	
12	"Local recurrence," pectoralis major, etc.	Very soon.	104	Erysipelas.	16 days.	98	5 years.	116	† Cause unknown.	1 year.	172	
13	Under scar.	(?)	108	Attack of dispnoea.	2 days.	101	4 years.	144	† Carc. of pleura.	1½ years.	177	
14	Scar.	8 months.	122	Pleuritis.	44 days.	17	10 years.	146	† Carc. of abdomen.	10 months.	179	
15	"Local recurrence."	2 years.	125	Erysipelas.	10 days.	109	3 years.	150	† General carc.	9 months.	180	
16	"Local recurrence."	4 months.	128	Oedema of lungs.	11 days.	112	3 years.	151	† Carc. of lungs.	1 year.		
19	"Local recurrence."	Immediately.	139	Sepsis.	6 days.	118	3 years.	154	† Metastases.	1 yr. 2 mos.		
20	(1) Scar.	3 months.	140	Sepsis.	Immediately.	119	3 years.	156	† Carc. of pleura.	3 months.		
	(2) Axilla.	6 months.	141			126	3 years.	157	† Unknown cause.	1 year.		
21	Axilla.	7 months.	142	Sepsis.	10 days.	182	2½ years.	161		† Less than 6 months.		
22	"Local recurrence."	Immediately.	143	Pneumonia and nephritis.	7 days.	183	3 years.					
23	"Local recurrence," 3 times.	Very soon after op.	127	Carc. liver.	Very soon.	184	2 years.	106	† Carc. of pelvis.			
24	Axilla and near scar.	4 months.	93		6 weeks after discharge.	185	2 years.	162	† Carc. pleura & lungs.			
26	"Local recurrence."	1 year.				186	2 years.					
27	Infraclav. glands.	4¼ years.				187	2 years.					
29	"Local recurrence," 5 times.	Very soon.				188	2⅓ years.					
30	"Local recurrence."	5 months.				189	2½ years.					
32	"Local recurrence."	10 months.				190	2 years.					
33	"Local recurrence."	Soon.				191	9 months.					
36	"Recurrence."	3 years 10 months.				192	1 yr. 10 mos.					
45	(1) Scar.	1 year.				193	1 yr. 10 mos.					
	(2) Scar.	2 years.				194	1 yr. 10 mos.					
	(3) Supraclav. glands and scar.	4 years.				195	2 yrs. 3 mos.					
48	"Recurrence."	† 14 months.				196	1⅔ years.					
49	Skin and axilla.	2 months.				197	1 yr. 7 mos.					
52	Axilla.	1½ years.				198	1 yr. 8 mos.					
54	"Recurrence."	1 year 10 months.				199	9 months.					
60	"Recurrence."	† 14 months.				200	1 yr. 7 mos.					
61	"Recurrence."	† 3 months.				201	1 yr. 7 mos.					
63	"Local recurrence."	† 1 year. † 2 years.				202	2 yrs. 1 mo.					
64	(1) Scar.	8 months.				203	1 yr. 4 mos.					
	(2) Scar.	11 months.				204	1 yr. 4 mos.					
66	"Local recurrence."	† 6½ months.				206	1 year.					
68	Scar, axilla and supraclav. gl.	Immediately.				207	1 year.					
71	"Local recurrence."	† 3 years.				208	11 months.					
73	Scar.	1 year.				209	5 years.					
74	"Local recurrence."	2 years.				210	1 yr. 4 mos.					
						211	10 months.					

79	Near scar.	1 year.
81	Near scar.	Very soon.
82	Scar.	1 year 7 months.
85	(1) Local recurrence.	5 months.
	(2) Scar and wall of thorax.	1 year.
86	Near scar.	18 days.
87	Supraclav. glands.	3 months.
88	" Local recurrence."	1 year 10 months.
89	Neck and scar.	2 months.
90	Scar in axilla.	7 months.
99	" Recurrence."	† 2 years.
105	" Recurrence."	1 year.
110	Supraclav. glands.	7 months.
111	Skin of breast.	3 months.
113	" Local recurrence."	3 months.
114	" Local recurrence."	6 months.
117	Scar.	4 months.
120	Recurrence near scar.	4 months.
121	Axilla.	8 months.
130	Scar.	Very soon.
123	" Recurrence."	1¾ years.
124	" Recurrence."	6 months.
129	" Recurrence."	† 1 year.
46	" Recurrence."	† 4 years.
94	" Recurrence."	† 1 year.
103	" Recurrence."	2¾ years.
132	" Recurrence " twice.	† 1 year.
145	" Recurrence."	† 6 months.
147	" Local recurrence."	3 months.
148	" Local recurrence " several times.	(?)
149	" Local recurrence."	Few months.
152	" Recurrence."	† 2 years.
153	" Recurrence." (?)	1 year.
155	Supraclav. glands.	5 months.
158	" Recurrence."	Less than 6 mos.
159	" Recurrence."	† Less than 2 mos.
160	" Recurrence " 3 times.	† 5 months.
115	Supraclav. glands.	2½ years.
163	Pectoralis major.	2 years.
164	" Recurrence."	3 times in 1 year.
166	" Local recurrence."	
167	Pectoralis major.	1 year.
170	Pectoralis major & supraclav. gl.	
171	" Local recurrence."	(?)
173	Skin.	2 months.
174	" Local recurrence."	1 year.
175	" Local recurrence."	1 year.
176	Scar.	6 months.
178	Pectoralis major.	7 months.
181	Scar and pectoralis major.	2 months.
205	" Recurrence."	1 year.
215	Scar.	10 months.
214		5 months.
216		5 months.
217		5 months.
218		4 months.
219		8 months.
220		8 months.
221		7 months.
222		7 months.
223		7 months.
224		7 months.
225		7 months.
226		5 months.

[15] 1. Zur Statistik der Mammacarcinome und deren Heilung. V. Schmid. Deutsche Zeitschrift für Chirurgie, Bd. xxvi, 1887.—2. Fünf Jahre im Augustahospital. Berlin, 1877.—3. Ein chirurgisches Triennium. Berlin, 1882.—4. Zur Behandlung des Brustkrebses. Verhandlungen d. deutsch. Ges. f. Chirurgie, 1883.

TABLE X.—LÜCKE (DIETRICH).[16] 1881-90. 110 CASES.

No.	Situation	Time p. o.
	Local recurrence	
5	"Local recurrence."	2 months. Patient lives.
11	Pect. major.	6 months. Patient lives.
13	Scar.	1 year.
	(2) Recurrence.	2 months. Patient lives.
24	"Local recurrence."	Died 3 months after operation.
26	Scar, vertebrae, leg.	2 months.
27	"Local recurrence."	months. (?)
28	"Local recurrence."	Very soon after operation.
31	Scar.	6 months.
	(2) "Local recurrence."	
32	Scar.	Few months.
34	Scar.	17 months.
35	"Local recurrence."	Died 4 years after operation.
36	"Recurrence."	1½ years.
39	"Local recurrence."	Very soon.
	(2) "Local recurrence."	Very soon.
40	Scar.	1 month.
42	Skin.	6 days before dismissed.
44	"Local recurrence."	7 months.
47	Axilla.	Few months.
49	"Local recurrence."	Immediately.
50	Skin.	Very soon.
51	"Local recurrence."	Died 13 months.
53	Axilla.	2 months.
	2d recurrence.	† 1 year.
54	Scar.	1 year.
55	"Local recurrence."	1 year.
56	"Local recurrence."	† 3½ years.
58	"Local recurrence."	† 7 months.
59	Ulceration in scar.	† 2 years after operation.
61	Scar.	1 month.
62	Scar.	24 days.
63	"Local recurrence."	6 months and 9 months.
64	"Local recurrence."	months. (?)
65	"Local recurrence."	Very soon.
66	"Local recurrence."	Very soon.
67	(1) "Local recurrence."	4 months.
	(2) "Local recurrence."	Very soon.
68	"Local recurrence.	1 year.
70	"Local recurrence."	† 3⅓ years.
71	"Local recurrence."	† 9 months.
73	"Local recurrence," axilla, sup. and infra-clav.	39 days.
74	"Local recurrence."	† 7 months.
75	"Local recurrence."	6 months.
	(3) Local recurrences.	†
76	"Local recurrence."	† 11 months.
77	"Local recurrence."	† 13 months.
78	"Local recurrence."	3 months or less.
	(3) Local recurrences.	
79	"Local recurrence."	† 9 months.
80	"Local recurrence."	† 7 months.
81	"Local recurrence."	† 13 months.
82	Scar.	4 months.
84	Axilla.	6 weeks.
87	Axilla.	22 days.
88	"Local recurrence."	† 10 months.

[16] Beitrag zur Statistik des Mammacarcinoms. Deutsche Zeitschrift für Chirurgie, Bd. xxxiii, 1892, 487.

LOCAL RECURRENCE, 66 PER CENT

Died soon after the operation			No note as to local recurrence			No local recurrence	
No.	Cause of death.	Time p. o.	No.	Cause of death.	Time p. o.	No.	Time p. o.
25	Pneumonia.	16 days after op.	41		† 7 months after op.	1	10½ years.
29	Erysipelas.	14 days after op.	69	Phthisis.	1¾ years.	2	7¾ years.
30	Erysipelas.	16 days after op.	72	Metastases.	† 15 months.	3	7 years.
33	Erysipelas.	16 days after op.	83	(?)	† 1½ years.	4	6¾ years.
37	Brain metastases.	39 days after op.	85	Old age.	† (?)	6	4¾ years.
46	Erysipelas.	14 days.	89	Liver metastases.	† Less than 6 mos.	7	4¾ years.
48	Lung embolism.	15 days.				8	4¾ years.
60	(?)	Soon after op.				9	4¼ years.
86	Oedema of lungs, cancer of lungs, liver, spleen, omentum.	10 days.				10	3¼ years.
						12	2 yrs. 10 mos.
						14	3¼ years.
						15	1¾ years.
						16	1½ years.
						17	13 months.
						18	1¼ years.
						19	1 year.
						20	1 year.
						21	1 year.
						22	1 year.
						23	10 months.
						38	† 4¾ years.
						43	† 1 year.
						45	† 2 yrs. 4 mos.
						52	† 4 years.
						57	† 4 years.

TABLE XI.—VOLKMANN (SPRENGEL).[17] 1874-78. 131 CASES.

Local recurrence

No.	Situation.	Time p. o.
1	Pectoralis major.	2 years.
2	Scar.	Less than 2 years.
3	Scar.	Less than 2 years.
4	Scar.	Less than 6 months.
7	Scar.	3 months.
9	Scar and axilla.	Less than 6 months.
10	Scar.	11 months.
12	Near scar.	2 months.
13	Scar and axilla.	1 year.
15	"Local recurrence."	Before healing.
16	Above scar.	2 months.
17	Near scar.	10 months.
18	Close to scar.	8 months.
19	"Local recurrence."	5 months.
21	Above scar.	Less than 2 years.
23	"Local recurrence."	Very soon.
25	"Recurrence," under pectoralis major.	1 month.
27	Scar.	Very soon.
29	"Recurrence," near scar.	4 months.
32	Scar.	Very soon.
34	Scar.	5 months.
36	Axilla.	5 months.
42	Scar.	5 months.
43	"Local recurrence."	Very soon.
47	Pectoralis major.	1 year.
48	"Local recurrence."	8 months.
49	"Local recurrence."	1 year 10 months.
51	"Local recurrence."	1½ years.
52	"Local recurrence."	Several times.
57	Scar.	10 weeks.
59	"Local recurrence."	† 1½ years.
61	"Local recurrence."	1 year.
65	Near scar.	Few weeks.
67	"Local recurrence."	2 years.
73	"Local recurrence."	Very soon after discharge.
74	Scar.	1 month.
79	Ribs and sternum.	
80	Near scar. (?)	1 month.
83	Axilla. (?)	(?)
86	(?)	About 1 year.
87	"Recurrence."	† 1 year.
89	Scar and axilla.	† Less than 4 months.
92	Skin and axilla.	Less than 1 year.
93	Sternum.	1 month.
94	Near scar and in axilla.	4 months.
95	"Recurrence," about scar.	10 months.
98	Near scar.	20 days.
100	Scar.	2½ years.
102	"Local recurrence," skin.	1½ years.
104	"Local recurrence," above scar.	† 6 months.
107	"Local recurrence."	Half year.
108	Scar and axilla.	3 months.
111	"Local recurrence," scar.	† 6 months.
113	During healing above wound.	
116	"Recurrence," axilla.	† 1½ years.
121	"Recurrence," axilla and skin.	2 months.
123	Scar.	11 months.
124	"Local recurrence."	† 1 year 10 months.
125	"Local recurrence."	1 year 7 months.
129	Scar.	2 months.
130	Scar.	1 year.
131	Scar.	6 months.

[17] Archiv. f. klin. Chirurg., Bd. xxvii, 1882.

LOCAL RECURRENCE, 59 PER CENT

Died soon after operation			No note as to local recurrence			No local recurrence		Result unknown
No.	Cause of death	Time p. o.	No.	Cause of death	Time p. o.	No.	Time p. o.	No.
6	Erysipelas and pneumonia.	1 day.	5	† Metastases.	4 months.	8	7 years.	66
20	Exhaustion.	19 days.	28	† Cancer of lungs.	2 years.	11	6 years.	68
24	Collapse.	15 days.	31	† Metastases.	1 year.	22	6 years.	77
26	Gangrene of skin.	20 days.	41	† (?)	2 yrs. 4 mos.	33	6 years.	97
30	Septicaemia.	6 days.	45	† Pericarditis.	6 months.	35	6 years.	120
39	(?)	2 months.	50	† Metastases.	2 years.	37	6 years.	
60	Bronchitis.	1½ months.	70	† Exhaustion.	1 year.	38	6 years.	
69	Septicaemia.	16 days.	81	† Cancer.	1 year.	40	† 9 months.	
119	Secondary lung embolism.	2 months.	82	† Cancer other breast	6 months.	44	6 years.	
122	Exhaustion.	16 days.	103	† Cancer of femur.	6 months.	46	† 6 months.	
128	Lung embolism.	23 days.	118	† Part of pectoralis major muscle removed.	9 months.	53	† 4 years.	
						54	1 year 3 mos.	
						55	† 1 yr. 7 mos.	
						56	5 years.	
						58	† 1½ years.	
						62	5 years.	
						63	2 years.	
						64	4½ years.	
						71	† 1 yr. 3 mos.	
						75	† 6 months.	
						76	† 1½ years.	
						78	† 2½ years.	
						84	2 years.	
						85	1 yr. after op.	
						88	4 years.	
						90	3½ years.	
						91	3½ years.	
						93	†	
						96	3 years.	
						99	3 years.	
						101	† 2 years.	
						106	† 4 months.	
						109	† 2½ years.	
						110	2½ years.	
						112	† 2½ years.	
						114	† 1¼ years.	
						115	† 9 months.	
						117	† 6 months.	
						126	2½ years.	
						127	2½ years.	
						72	3 months.	
						78	3 months.	
						14	3 months.	

EXPLANATION OF PLATES

PLATE XLIX.—Diagram showing skin incisions, triangular flap of skin, *abc*, and triangular flap of fat.

PLATE L.—Diagram to elucidate Plate LI. *M*, Major pectoral muscle; *m*, Minor pectoral muscle; *S*, Apex of infraclavicular fat below the subclavian vessels; *S'*, Apex of fat above the vessels.

PLATE LI.—Photograph of field of operation, taken just before the final cut which severs from the body the mass which has been extirpated.

PLATES LII, LIII and LIV are from photographs of the fresh tissues and show the amount excised in three typical cases of breast cancer.

PLATE LII.—The glands, although involved, were not surely palpable before the operation.

PLATE LIII.—The skin was so extensively involved and so liberally excised that the subcutaneous tissues removed are almost completely concealed by it. The highest axillary and the supraclavicular glands were involved. The clavicle was sawed through to insure a more thorough removal of the tissue in which the glands were imbedded.

PLATE LIV.—Shows the amount of subcutaneous tissue removed even when the skin is not extensively involved. The axillary vein was excised in this case because it was imbedded in tissues infiltrated with cancer.

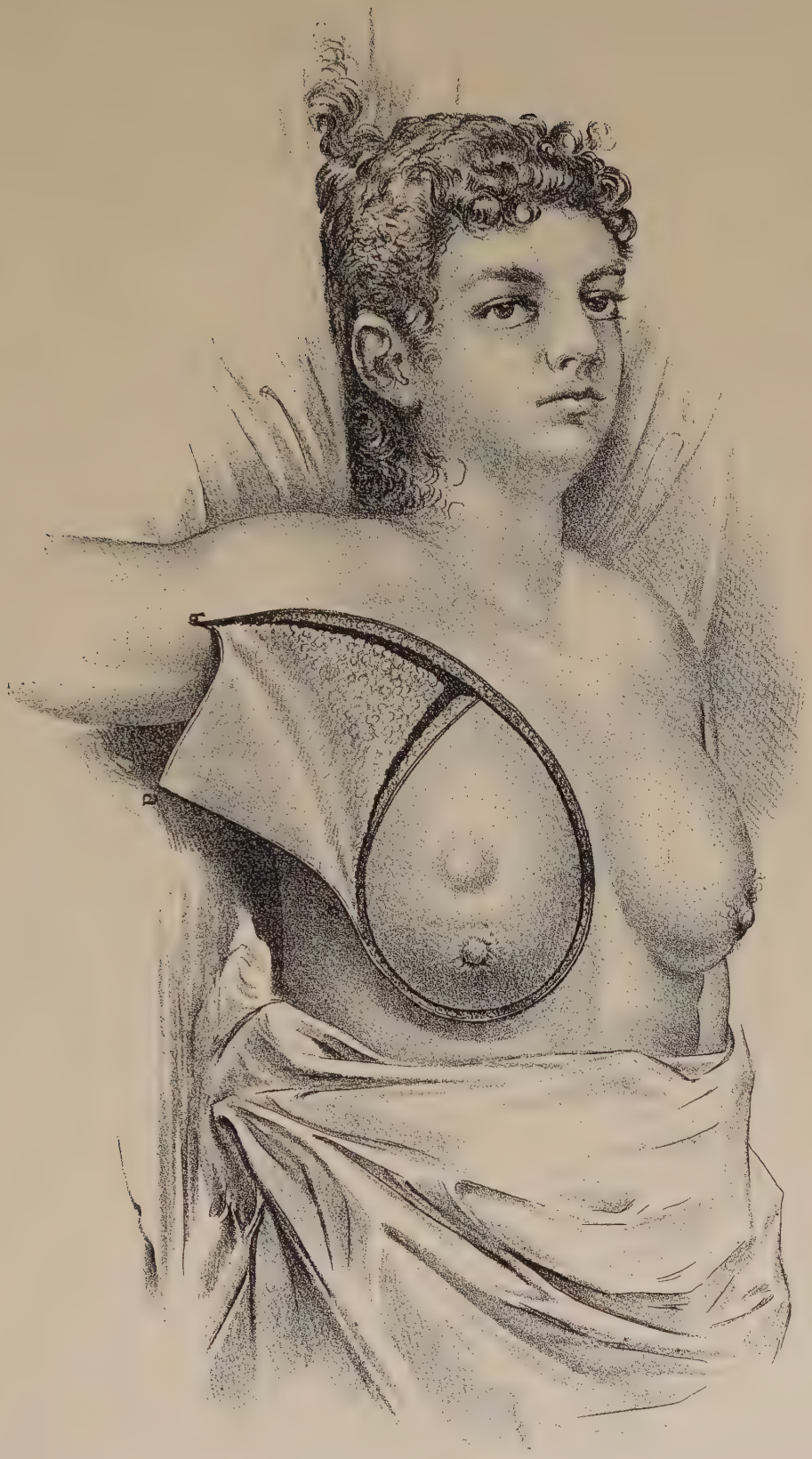


PLATE L

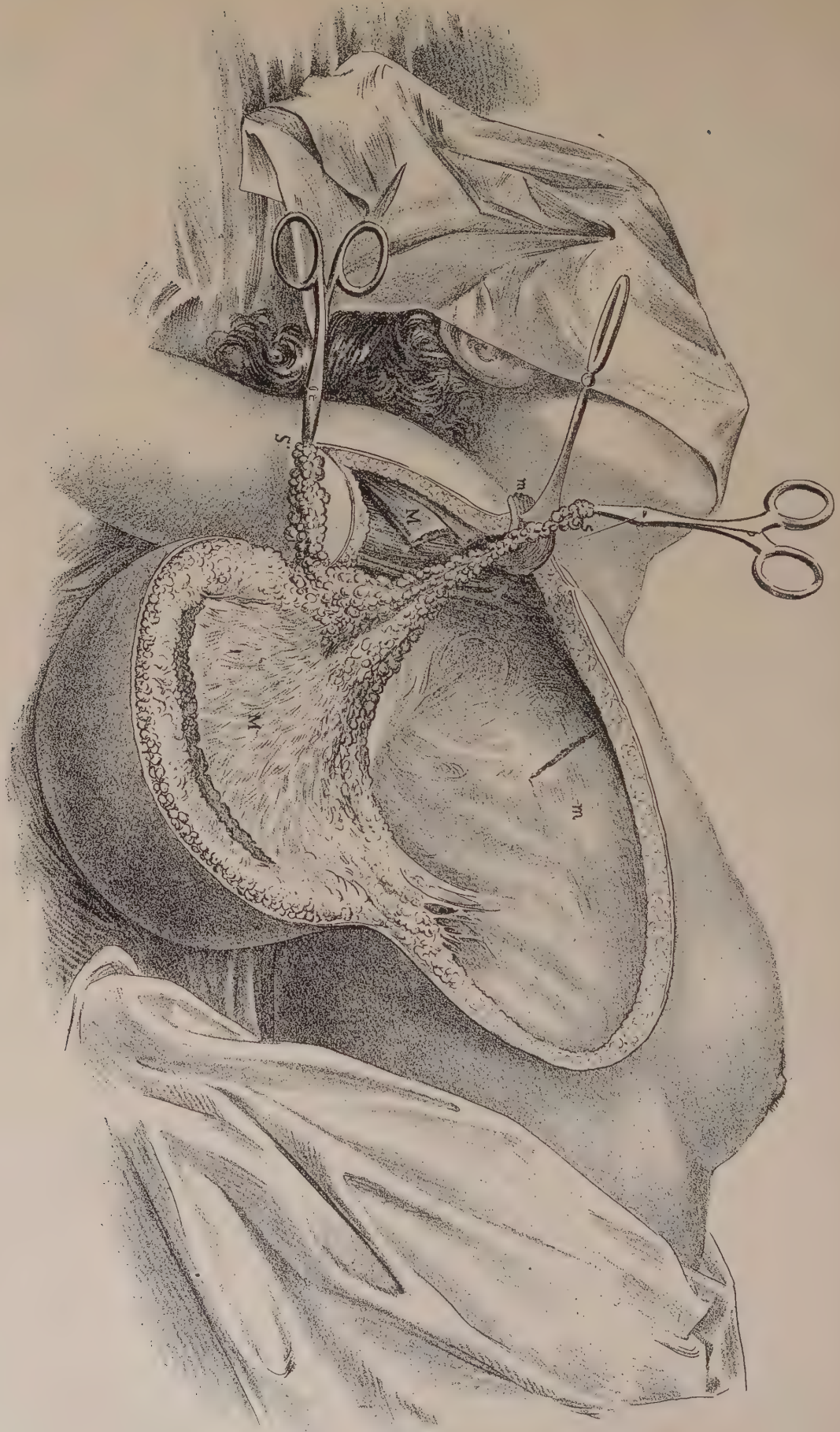
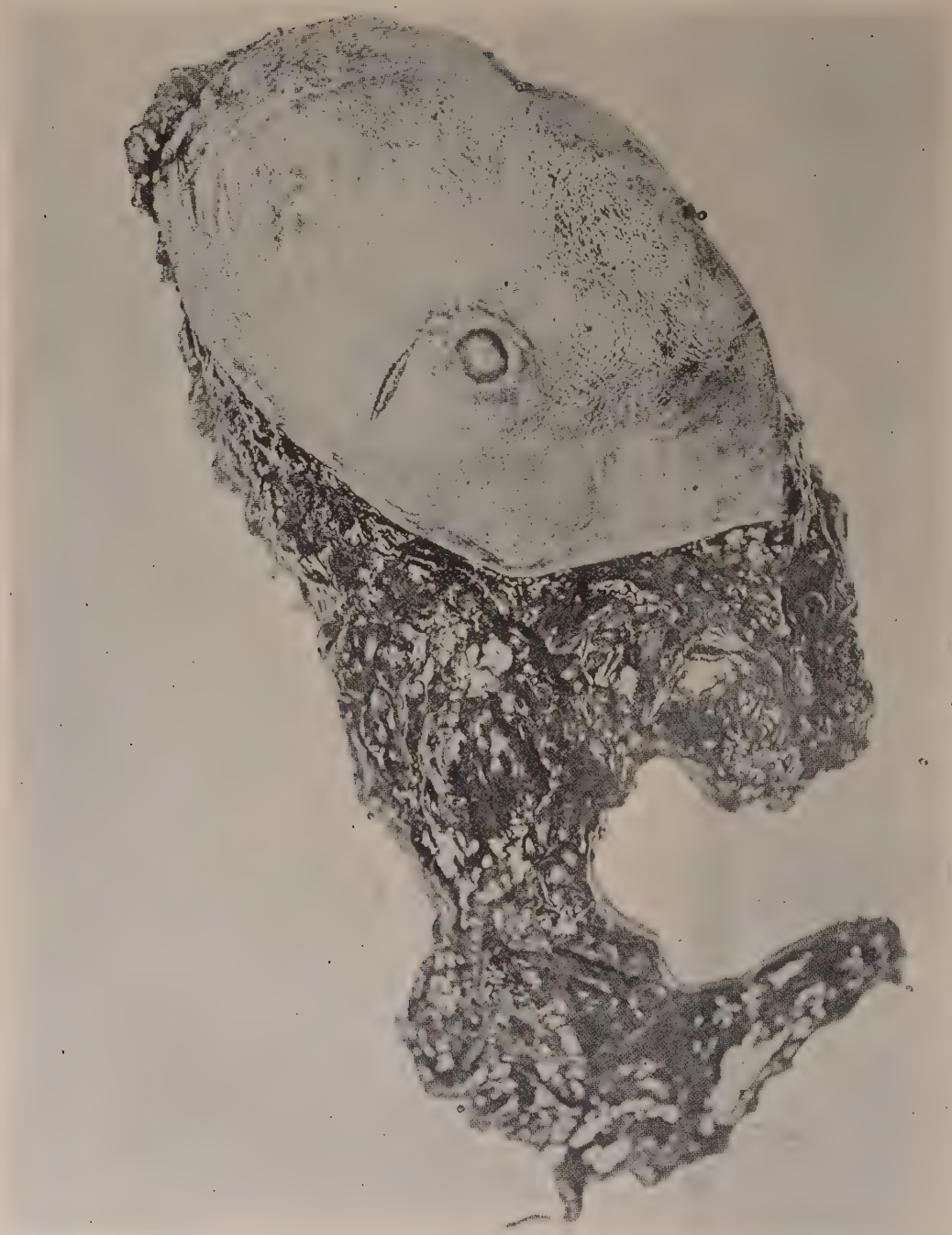


PLATE LII



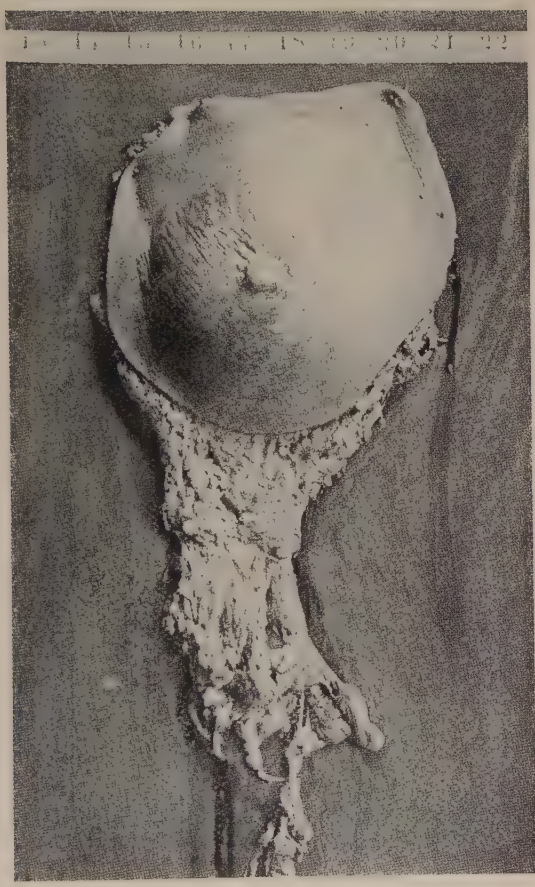


PLATE LIV

A CLINICAL AND HISTOLOGICAL STUDY OF CERTAIN ADENOCARCINOMATA OF THE BREAST

AND A BRIEF CONSIDERATION OF THE SUPRACLAVICULAR OPERATION AND OF THE RESULTS OF OPERATIONS FOR CANCER OF THE BREAST FROM 1889 to 1898 AT THE JOHNS HOPKINS HOSPITAL[1]

When our Secretary, Dr. Burrell, graciously urged me to introduce the subject of breast cancer for discussion at this meeting, and to tell you something of the results of our experience in the treatment of this disease, it seemed to me that it would be a very simple matter, for our cases have been many and our interest in them great.

It would be profitable, I thought, to review with you some of our work from a pathological, as well as a clinical standpoint, with a view to determine, as far as possible, the relative malignancy of the various cancers of the breast. For the physician, as well as the layman, a cancer of the breast is a cancer of the breast, and efforts to classify these tumors have not been very successful. But the riches of our cancer storehouse embarrass me, and I prefer in the time allotted to ask your attention to the description of one or two quite rare but definite varieties of breast cancer which we have encountered with sufficient frequency to enable us to recognize them clinically as well as histologically.

We have truly a cancer storehouse, for we save all of our malignant tumor material. In breast cases the entire mass—fat, muscle and all—is saved. Before it is severed from the body, in the course of the dissection, ligatures black and white are placed in it, here and there, as landmarks. When a flap of skin is to be dissected back its tip is left in situ, as a bearing point on the tissues to be removed. If by accident or design a scrap of tissue is dissected during the operation from the tumor mass, it is at once labelled. When we are in doubt as to the cancerous involvement of the minute gland at the highest reachable point below the clavicle, it is sometimes dissociated by a special ligature. In making the incisions for the macroscopic examination of the tumor the best interests of the microscopic work are considered. We are, if possible, more fully convinced than ever of the value of painstaking scrutiny of the naked-eye appearances, and of detailed descriptions

[1] Presented before the American Surgical Association, New Orleans, La., April 21, 1898.

Tr. Am. Surg. Ass., Phila., 1898, xvi, 144-181. (Reprinted.)

Also: Ann. Surg., Phila., 1898, xxviii, 557-576.

of all that can be seen on the freshly cut surfaces of the tumor, and of the appearance and relation of the outlying parts. We have had occasion to regret the fact that the macroscopic findings have been insufficiently portrayed in some few of our earlier cases.

The block dissected from the neck, and eventually from the mediastinum, should be oriented, before hardening, as accurately as the main mass. The tissues should be hardened in Müller's or Zenker's fluid rather than in formalin or alcohol. If formalin should seem desirable in some special case, it might be used for three or four hours, after which Müller's fluid is to be substituted. Formalin interferes with the differentiation of elastic tissues by the orcein stain.[2]

One person should be responsible for the preservation of the breast material from first to last. This was no light responsibility, even when the material was not nearly so abundant with us as it is at present.

Above all, the operator himself should study the material, in the operating room, immediately after the operation, and in the laboratory.

There is a gap between the surgeon and pathologist which can be filled only by the surgeon. The pathologist seldom has the opportunity to see diseased conditions as the surgeon sees them. A tumor on a plate and a tumor in the breast of a patient, how different! Its blood, its color, its form, its freshness, its consistency, are more or less lost when the tumor has been removed; the translucent zone of certain rapidly-growing cancers soon becomes opaque. Furthermore, the gross appearance of the new growth has for the surgeon a vital interest. He must decide at the operating table not only what is to be done at the moment, but he should be able to give a more or less accurate prognosis. If there is a difference in the malignancy of malignant tumors the operator, above all others, is the one to whom we should look for its interpretation. Not only are his opportunities greater than the pathologist's, but the incentive for the study of the fresh as well as of the hardened specimen is infinitely greater.

The patient's first impressions of the tumor, the presence or absence of pain at the beginning, the gradual increase of pain from almost imperceptible beginnings, the life of the new growth, the gradual disappearance of the fat between tumor and skin, the discoloration of the skin over the tumor or in its neighborhood, the local changes in the venous, arterial, capillary, and lymphatic circulations, the involvement of the skin and of the parts underlying the tumor, the shape and appearance of the tumor, the condition of the nipple as compared with its fellow, the gradual shifting of nipple (it may reach the axillary line), the comparison of the two breasts, of the axillae, of the supraclavicular fossae and of the groins, the circulation of

[2] E. Goldmann. Beitrage zur klin. Chirurgie. Bd. xviii, p. 595.

the arm of the affected side, the involvement of the skin by metastases, of the pleura, bones, and viscera, etc., these are some of the conditions which interest the operator more than the pathologist, and may assist him ultimately in connection with his study of the new growth itself to make some sort of a classification of breast cancers, and to determine their relative malignancy.

That breast cancers are not all alike every clinician knows; to some the patient succumbs in a year or less, others are borne for twenty years or more.

I know of no very successful attempt at classification of cancers of the breast with reference to their relative malignancy, and yet the importance of such a classification, if it were to any extent possible, is so evident that it is unnecessary to emphasize it. The histories alone, of the operated as well as the unoperated cases, give one a hint that there must be some basis for such a classification.

Many cancers of the breast contribute little if anything to the size of the organ, but some, certain adenocarcinomata and encephaloid cancers, for example, form tumors with considerable dimensions; the former may exhibit a slight tendency to pedunculation.

I find myself becoming inclined to welcome largeness, a suggestion of constriction at the base of cancers of the breast, and a tendency to break down as relatively favorable signs.

It would seem that we have been fortunate in meeting with a number of unusual adenocarcinomata, some of which have, perhaps, never been described; they may, however, have been seen and even described, but described beyond recognition. I have read long and careful descriptions of the minute appearances of tumors which might be interpreted to mean almost anything. If drawings were to be made by several individuals based on some of these descriptions, I doubt if any two of them would depict the same thing.

The particular adenocarcinomata which are so full of interest for us at this time, and to which I shall first call your attention, I do not find described; and yet they are not so very uncommon. We have encountered five or six of them in less than 150 cases of breast cancer.

Permit me to proceed at once to a very brief consideration of these cases:

Case I.—*Malignant adenoma* (*adenocarcinoma*). Surg. No. 6286; Path. No. 1705. Mrs. L. M., white, aged sixty-seven years, presented herself February 16, 1897, with a tumor growing in the site of a scar over the right breast. Two and one-half years before admission the patient struck her right breast in a fall; one month thereafter she noticed in this breast a little lump, the size of a pea, just under the skin. Within a year the tumor grew painlessly to be as large as a fist. Eight months before admission the tumor was removed by a local surgeon. At that time the skin over the tumor was bluish but not broken. Since the operation there has been a rapid recurrence of the

tumor, associated with occasional sharp shooting pains. There has been no loss of weight or strength.

This patient was presented to me for the first time at my clinic, where I discussed the tumor, at length, before the class. It was a fungating tumor, pedunculated, and occupied the lower portion of the scar. There was also a small nodule in the upper end of the scar (see Plate LV).

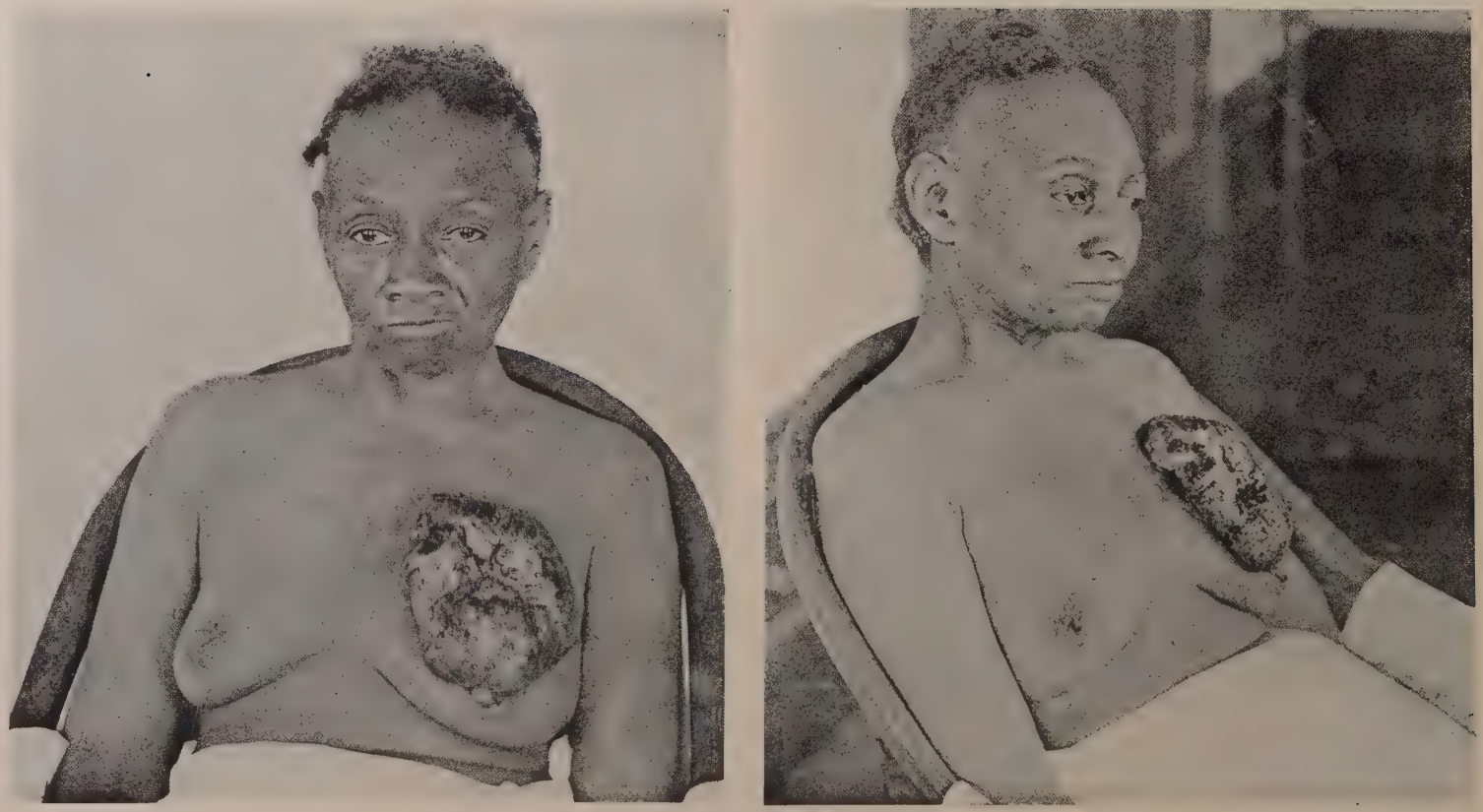
The entire convex surface of the tumor was ulcerated. One could squeeze a serum-like fluid from the tumor, the surface of which was covered by a necrotic film. I told the class that the tumor was certainly not an ordinary carcinoma, because of the considerable pedunculation, the peculiar serous fluid, the consistence of the tumor, etc. It was softer than the ordinary carcinoma of the breast, considerably softer everywhere except in one place, and this particular place, which was harder and could not macroscopically be distinguished from carcinoma, proved microscopically to be an adenocarcinoma in which the cells had already ceased to form any very definite combination figures. The tumor was removed at this same clinic by Dr. Finney, and the axilla was dissected out in the usual way. The glands in the axilla were enlarged, but careful microscopical examination of several of them has thus far failed to furnish evidence of carcinomatous involvement. The enlargement was due chiefly to endothelial proliferation.

That these glands were not carcinomatous, notwithstanding the fact that this was a recurrent tumor, would, in itself, have been very strong presumptive evidence that the tumor was not an ordinary carcinoma. Plate LVIII represents one microscopic field of this tumor. You will see at once how very different it is from any of the carcinomata of the breast which are described by the authors. Please observe that the tumor is made up chiefly of very large tubes which are lined with epithelium many cells deep.

In some of the tubes these epithelial cells might seem, at first sight, to be disposed without attempt at arrangement, but a second glance discovers cell combinations which have resulted in the formation of gland-like figures, circles, and tubes, and columns, and minute papillae. The cells are often so snugly fitted together in these heavily-lined tubes (or heavy tubes) as to conceal the original figures; but almost always, even when the tubes are completely filled with tightly packed cells, one can detect little circles of cells or little tubes which betray the tendency and the ability which the cells still have to form definite combinations. Sometimes columns and circles anastomose in such a way as to form a mesh or more or less open network when there is room enough for such figures.

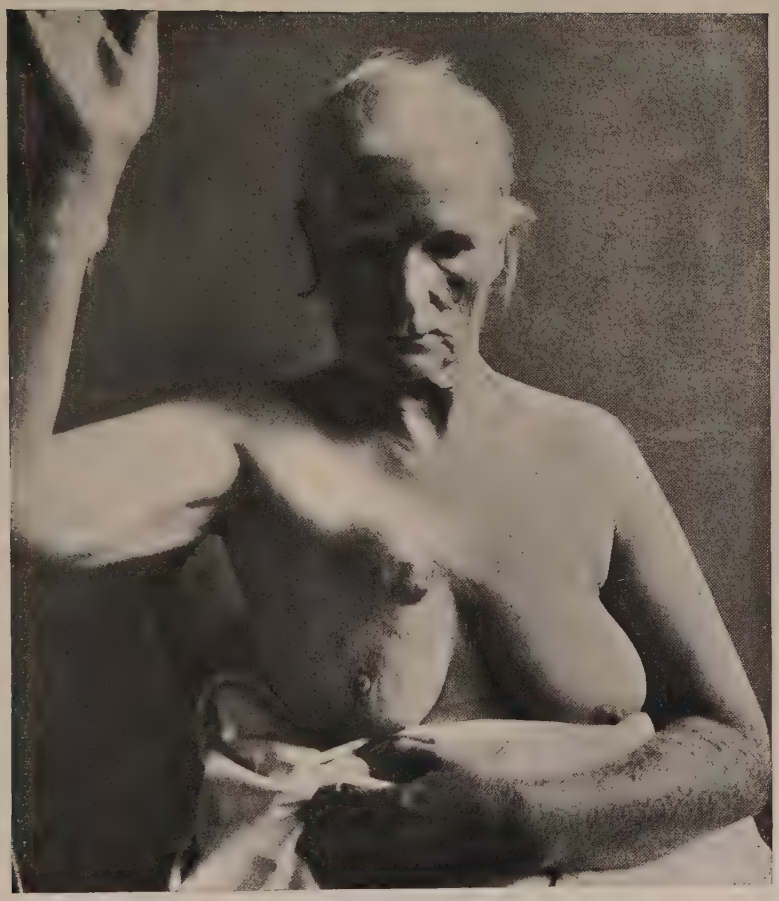
In certain parts this tumor has become pure carcinoma and has lost its adenomatous type; the epithelial cells, having lost their power to form combinations, lie irregularly and closely packed together in lymph-spaces.

Recurrent Adenocarcinoma of the Breast.
Patholog. No. 1705.

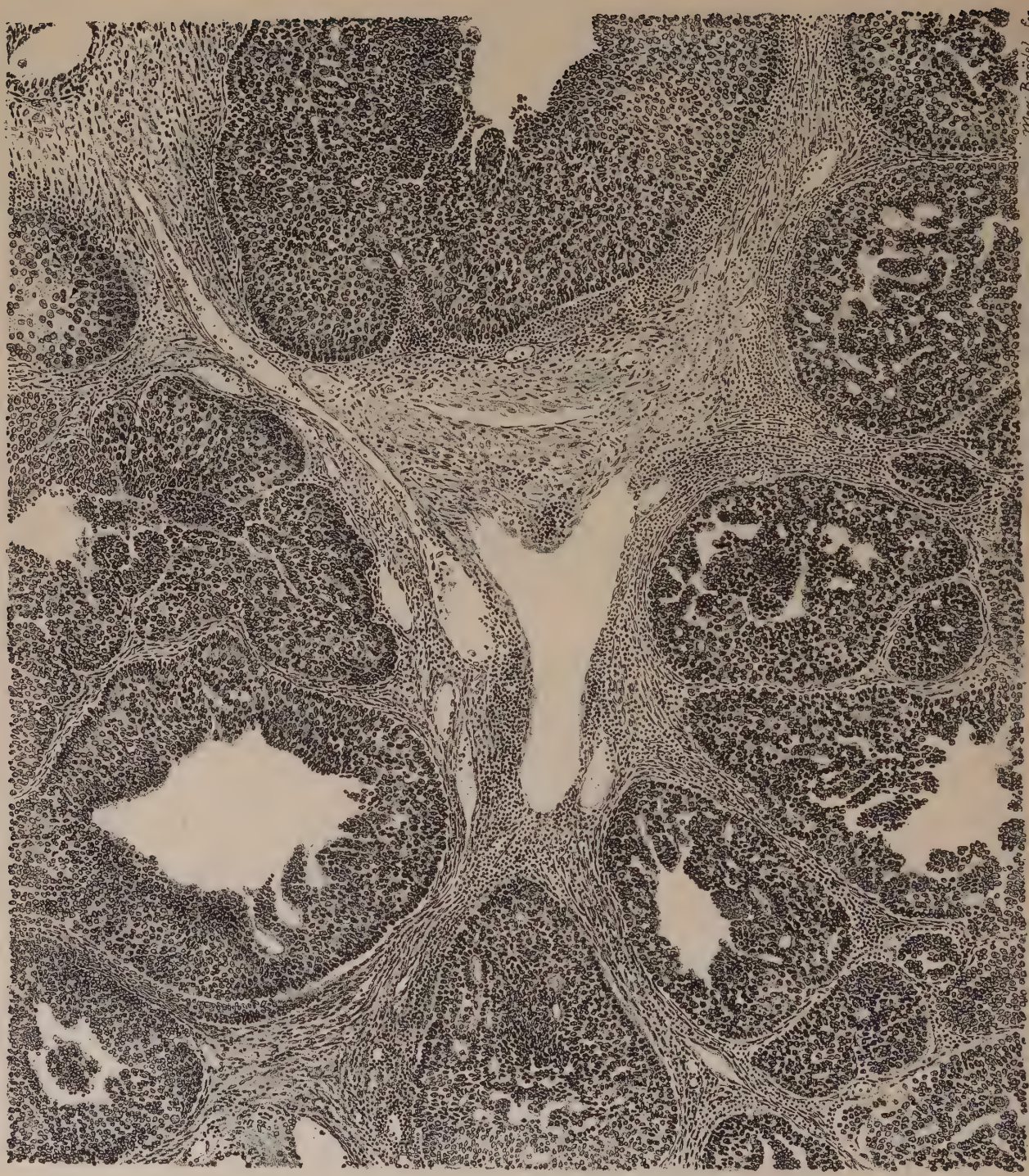


1. 2.

Adenocarcinoma of the Breast. Patholog. No. 511.



Adenocarcinoma of the Breast. Patholog. No. 204.



Adenocarcinoma of the Breast. Patholog. No. 1705.

Last September this patient wrote us that she was perfectly well, and that she was unable to detect any sign of a local recurrence of the tumor.

Sometimes the carcinoma and this peculiar adenoma, with its large heavily-lined tubes, seem to be growing side by side and independently, the carcinoma infiltrating the stroma, we might say, of the adenoma and suggesting, for the moment, a bitypic form of tumor. This bitypic form of growth characterized certain parts of the tumor in the following case:

CASE II.—*Malignant adenoma* (*adenocarcinoma*). Surg. No. 3175; Path. No. 511. Mrs. Mary P., colored, aged fifty years. Admitted June 14, 1894, with a large fungating mass, measuring 12 cm. by 14 cm., in the upper and outer quadrant of the left breast (see Plate LVI, 1 and 2). Three years before admission patient first noticed a small nodule in this breast which has been growing steadily and painlessly ever since. For nearly two years the skin remained intact. Since September, 1893, nine months prior to admission, there have been frequent haemorrhages from the surface of the growth, caused, probably, by the sticking of the dressings. A thin, sanious, foul-smelling fluid constantly exudes from the surface of the mass. The edges of the tumor overhang the skin for about 1 to 2 cm. on all sides. There was evidence of cancerous involvement of the neck of the uterus; nevertheless a complete breast operation was performed. The prognosis, so far as local recurrence was concerned, was unusually favorable: the axilla was not involved; the enlarged lymphatic glands showed endothelial hyperplasia.

When we state that an axilla is not involved we mean that every gland and all of the fat having been exhaustively examined with the microscope, no evidence of cancer has been discovered.

The microscope, as I have said, revealed this association of the heavily lined, very large tubules in which the epithelial cells have preserved their ability to make more or less definite cell-combinations, and the small cancer alveoli occupying bitypically, as it were, the stroma of the adenoma. In other tumors and in other parts of this tumor one can see what would be called the transitions in all the desired forms, from the heavy tubes lined with cells in definite combinations to the finest lymph spaces containing three or four epithelial cells without arrangement. We are often able to trace, even in the metastases of the purer carcinomata, indications of a tendency in the cancer cells to form combinations which recall the gland structure. This patient died of the cancer of the uterus, two and one-half years after the breast operation. There was no recurrence of the breast tumor.

The following case does not strictly belong to this group. I introduce it because it presents in places a type of tumor which might, for the present, be regarded as transitional to the adenocarcinomata to which I have invited your attention.

CASE III.—*Scirrhous carcinoma and intracanalicular papillary adenocarcinoma* (*"duct cancer"*). Surg. No. 6059; Path. No. 1611. Mrs. J. M.

S., white, aged sixty-one years. Admitted November 30, 1896. Carcinoma of right breast, axilla, and supraclavicular glands. Metastasis in left femur, followed by fracture. Probable local recurrence near sternal edge of scar.

Patient did not suspect that she had a tumor until February, 1896. An increase in the size of the affected breast called her attention to it. She then examined it for the first time, and discovered a hard mass in the neighborhood of the nipple to which the skin was already adherent. She soon began to notice occasional stabbing pains, but otherwise experienced no discomfort from the new growth which, instead of growing larger, steadily decreased in size from the time when she first discovered it until she came to the hospital. No fluid had ever escaped from the nipple.

On admission, the nipple was tilted upward; the eye detected no tumor in breast, axilla, or neck. The skin covering the breast was not ulcerated, but it was adherent to an underlying mass which could be felt surrounding the nipple. No fluid could be expressed from the nipple. Chart No. 1611 (not here reproduced), which Dr. Cushing kindly painted for me from the fresh specimen, shows the appearance of a section through the nipple and centre of the breast. A number of minute cysts were encountered in this section; two of them, larger than the others, are accurately represented in the colored chart. The largest of these two cysts measured 1 cm. in diameter, and was almost filled by a little pedunculated ingrowth. The smaller cyst also contained a minute papilloma. Both of these larger cysts and some of the smaller ones scattered throughout the breast contained a dark and almost black fluid. Minute cysts in other parts of the gland were filled, some with a reddish-brown, some with amber-colored fluid, and some with contents resembling milk, or pus, or cheese. The smallest of these cysts formed hard shot-like bodies in the breast, which can sometimes be diagnosticated by palpation through the skin.

A diffuse scirrhous growth, about 3 cm. by 3 cm., in which the larger and many small cysts were embedded, occupied about the centre of the breast and involved the overlying skin and the nipple. It was impossible with the naked eye to determine the limits of this cancer. Dr. Cushing succeeded in cutting and mounting a section of this tumor, which shows the tissues surrounding the cyst, the wall of the cyst, the pedunculated growth, and even the pedicle of the papilloma; and Dr. Hugh H. Young made for me the wall-chart, which represents so beautifully the microscopic appearances. Plate LIX, drawn by Becker, is a faithful interpretation of the same section. The pedunculated ingrowth is not one of the ordinary varieties of benign intracanalicular papilloma. It has very little stroma; just enough, perhaps, to support the parenchyma. It is chiefly parenchyma, and the epithelial cells form, apparently, combinations resembling those which we have described in the previous two cases—combinations which result in the formation of the large heavily-lined tubes. The pedicle is very delicate, transmitting a few vessels, but consisting chiefly of epithelium many rows deep on the surface, and exhibiting the tendency wherever feasible to form

the heavy tubular combinations referred to. In the wall of the cyst, but one or two millimetres from its lining, we meet carcinoma in which the cells have lost their power to form glandular combinations, and appear as ordinary cancer cells incapable of further differentiation. In the glands of the axilla and in the neck were found metastases, most of them undifferentiated cancerous metastases, but some of them revealing the glandular type. This patient died one year after the operation, with metastases.

The above case is a true scirrhous cancer, starting probably in the wall of a cyst, and should not be classed with the other five adenocarcinomata; but in Plate LIX you will observe that the cancer (*c. c. c.*) surrounds a little field of intracanalicular papillomatous adenocarcinoma (the villous carcinoma of Cornil and Ranvier, and the duct cancer of the English surgeons), which recalls in places certain pictures which are familiar ones in the other five adenocarcinomata. Large, heavy tubes there are, two or three of them, which resemble the heavy tubes of the other tumors, but are not precisely like them. There seems to be no tendency in the tubes of the duct cancer to form the rings and other cell-combinations which characterize the other five adenocarcinomata; and there is in this miniature duct cancer, as in all duct cancers, a very conspicuous tendency to produce intracystic villous growths (see Plate LIX).

Case IV.—*Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 123; Surg. No. 2337. Mrs. M. P., white, aged sixty-five years. Admitted July 7, 1893. Eleven months before admission patient had noticed a tumor the size of a "walnut" in her left breast. On admission this tumor in the upper and outer quadrant measures 4 x 3 x 3 cm. It is not adherent to the skin or muscle, and the nipple is not in the least retracted. The complete operation below the clavicle was performed by Dr. Finney. In a note on the macroscopic appearance of a section through the middle of the tumor, Dr. Bloodgood emphasizes the fact that, on pressure of the tumor, a number of long, very fine, soft cylinders were extruded from the cut surface. These were, probably, the partially necrotic contents of the large tubes which I have described.

This was our first case of this variety of tumor. The axillary glands showed endothelial hyperplasia, but no metastases. The tumor was a malignant adenoma of precisely the same variety as those already described; but the type had remained pure, there being no areas of pure carcinoma and no transitional pictures. We had a letter from this patient a few days ago (April, 1898), stating that she was perfectly well, and that, so far as she knows, there is no evidence of local recurrence and none of metastases.

Case V.—*Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 204; Surg. No. 2565. Mrs. S. G., white, aged sixty years. Admitted October 18, 1893. Patient stated that five years before admission to the hospital she

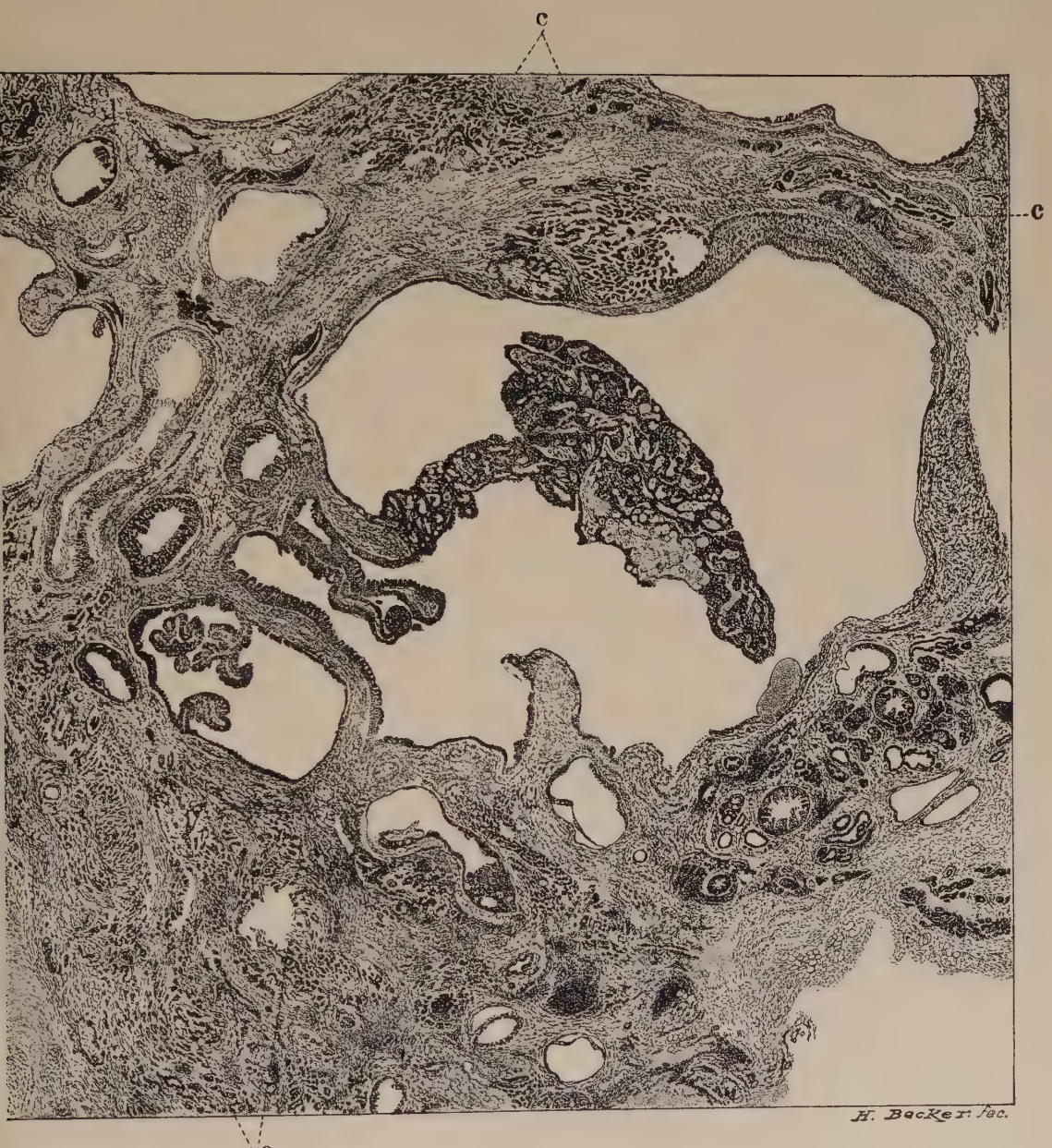
bruised the right breast badly; three months thereafter she noticed a small lump in this breast, which four years later became adherent to the skin. When operated upon the tumor measured 4 x 4 x 3 cm.; it occupied the upper part of the upper and outer quadrant of the breast, over the sternal origin of the pectoralis major muscle. It was adherent to the discolored skin and apparently to the pectoral fascia. Plate LVII, although not a good one, shows at least that the growth was exuberant and would soon have become fungating. At the operation the prognosis was considered favorable, except for the fact that the muscle over the sternal ends of the second, third, and fourth ribs was infiltrated. It was, however, possible to give the local growth a fairly wide berth.

Microscopical examination. The tumor involved both skin and muscle, but there was no evidence of metastatic involvement of the muscle or other tissue. The axillary glands were enlarged (endothelial hyperplasia), but metastases have not been found in them.

April 1, 1898, four years and six months after the operation, this patient was examined by Dr. Bloodgood, who reported a perfect result; free use and no swelling of the arm, no sign of recurrence or metastases, and excellent health of patient.

Case VI.—*Malignant adenoma* (*adenocarcinoma*). Path. lab. No. 994; Surg. No. 4420. E. M., white, single, aged forty-two years. Admitted to the hospital July 15, 1895. One grandparent, one uncle, and one sister died of cancer; the sister with cancer of the breast. Scattered through the breasts are small hard nodules, from 3 to 5 cm. in diameter; in the left breast, the lower and inner quadrant, is a nodule harder and more tender than the rest, and which the patient has noticed for about three months only. This nodule measures about 2 x 3 cm. and is freely movable. The skin over the breasts is everywhere normal. The nipples are not retracted. The axillary and inguinal glands on both sides are sufficiently enlarged to be easily felt. July 17, 1895, the comple infra- and supraclavicular operations were performed by Dr. Bloodgood.

The suspected tumor occupied the sternal border of the lower and inner quadrant of the breast; it was very hard and irregular in outline, not circumscribed, and everywhere surrounded by breast tissue; on section it cupped, and from the cut surface, on which could be seen little yellow dots and lines, there could be expressed a soft, rather granular material. The breast tissue on the confines of the tumor differed in appearance from the rest of the gland, being pink in color instead of pearly-white, and studded with minute haemorrhagic points. Between the nipple and this tumor is a second tumor resembling those found elsewhere in the same breast. On section this little tumor, 1 cm. in diameter, instead of cupping, becomes elevated about 2 cm. above the surrounding tissue; it is lobulated, and nothing can be expressed from its cut surface. Between this second tumor and the first there are smaller lobulated nodules resembling the main tumor in that a few minute areas of necrosis can be seen and partly expressed. Throughout the breast tissue, both outside of and within the nodules, are little cysts, brownish in color and containing a clear fluid.



Carcinoma of the Breast, *c, c, c,* and Intracanalicular Papillary Adenocarcinoma. Patholog. No. 1611.

Microscopic examination. The principal tumor is an adenocarcinoma of the large, heavy-walled cylinder type which we are considering. The axillary glands, macroscopically large and soft and somewhat haemorrhagic, contain no metastases. This patient was heard from a few days ago (April, 1898). She reports herself perfectly well, with no sign of recurrence of the tumor, three years and nine months since the operation.

In five of these cases we have an adenocarcinoma of a type so distinct that we may advantageously consider them, for the present at least, as constituting a more or less specific class. In Cases IV (123), V (204), and VI (994) this adenoma is pure throughout the neoplasm; Case VI was operated upon nearly three years ago, Cases IV and V nearly five years ago. Within the last three weeks they have all reported themselves as perfectly well and without a sign of return of the disease. In Case I (1705) the change from the adenocarcinoma to the purer carcinoma is apparently just beginning to take place in certain parts of the tumor, but the axillary glands, although much enlarged from endothelial hyperplasia, show no involvement. This patient is also living without doubt; we heard from her last September in reply to our last letter.

In Case II (511) this same adenoma and the carcinoma were growing side by side in many parts in the bitypic manner already described, and still the axilla was not involved. This patient had a cancer of the uterus when we operated upon her breast. If the uterine tumor had been operable this patient might still be living.

The five cases of adenocarcinoma which we have very briefly considered this morning resemble in certain respects, and in other respects differ from, the so-called duct cancers. The duct cancers hitherto described have been small tumors, for the most part circumscribed, and resembled sarcomata; macroscopically as well as microscopically the villous nature of the tumor has always been conspicuous. That they bulge on section is frequently noted in the descriptions of these duct cancers; and by most they are said to be soft, very friable, and difficult to cut.

The adenocarcinomata which I have described resembled on section the carcinomata and not the sarcomata; a villous or papillomatous tendency was never apparent and not even suspected from the gross appearances of the freshly cut surfaces. Fine worm-like cylinders of epithelium could be expressed from some of these tumors, but not from all. All of these new growths infiltrated the surrounding tissues just as carcinoma does. With the microscope the power of the epithelium to make ring-like combinations, as shown in the drawings, was very conspicuous, whereas the tendency to form villous growths was not so evident.

I must not weary you further by describing the finer structure of these tumors. The histological details are reproduced with most gratifying truth-

fulness in the plates; and, when a sufficiently high power has been employed, each nucleus has been copied as faithfully as possible.

We have, I think, said enough about these adenocarcinomata to make it clear that they have striking clinical and histological features in common; but we shall probably not succeed in drawing a very sharp line between this particular variety of adenocarcinoma and certain other adenocarcinomata in our collection. Some of the latter resemble the two cases described by Billroth as cystoadenomata; others, the thyroid gland. In one case the resemblance to the thyroid gland was remarkable.

It is possible that some of the little tumors which have been described as duct cancers are early stages of these adenocarcinomata.

We have several times met with just such cases as No. 111—a cyst or cysts with intracystic papillomata, and scirrhous cancer at the base of the villous growth.

[The writer then described with some detail the cancer cysts, of which he had seen six. He emphasized the fact that the cancerous walls of these cysts may be very little thicker than the wall of an ordinary retention cyst of the breast, and that the surgeon who was not aware of the existence of these cancer cysts, or to whom the appearance of the wall was unfamiliar, would almost surely regard them as innocent; for the cancerous wall of these cysts is often not much thicker than the wall of a benign cyst, and usually is, at least, too thin to show the well-recognized cancer markings. For years it has been the writer's custom to demonstrate what he calls a cancer edge. The edge is made with a sharp knife by two cuts at right angles to each other. This edge becomes rounded on handling, but does not fray out as an edge in pure connective tissue would do; and does not squeeze down as it would if inflammatory products contributed to its support. When the cancer is young, or if it is rapidly growing, there is a certain translucency which assists the diagnostician. It is, of course, only when the growth is very small indeed that these aids to diagnosis are required. When the neoplasm is a few lines thick the diagnosis, at least so far as malignancy is concerned, is usually not difficult even for the novice.]

Our present method of operating for the cure of breast cancer is even more radical than it was at the time of the writer's first publication on this subject. The supraclavicular region is almost invariably cleaned out. To do this we no longer divide the clavicle as we did five or six years ago; for simple division of the clavicle does not facilitate the dissection much, if any, and the removal of a piece of the collar-bone is a procedure which maims without sufficient compensation. If it were very desirable to remove

the supraclavicular contents in one piece with the axillary contents and the breast, one might not hesitate to excise, if necessary, even the entire clavicle; but the removal of the supraclavicular fat and lymphatics is best done from within outward and from below upward, for in cleaning large veins like the subclavian and internal jugular the surgeon works to the best advantage if he starts at the vein and works away from it. The subclavian vein being the starting-point in the dissection of both the infra- and supraclavicular regions, it is unnecessary to remove the clavicle and useless to divide it. By elevating the shoulder the clavicle can be raised an inch or more away from the first rib when the operation is so far completed as to make this desirable. The web of fibrous tissue which binds the subclavian vein loosely to the clavicle is thus spread out, and can be easily removed. The fingers can be passed from the supra- to the infraclavicular and to the subscapular regions under the clavicle, and any fat in the latter region, near the internal or the posterior border of the scapula between the serratus magnus and subscapular muscles, which could not be reached from the axilla can be drawn out through the neck. Dr. Bloodgood was, I believe, the first to demonstrate the advantages of completing the cleaning out of this postero-internal subscapular region by the supraclavicular route. To excise the supraclavicular tissues we use a vertical incision parallel with the sterno-cleido-mastoid muscle near its posterior border; a few of the posterior fibres of this muscle are divided and the junction of the internal jugular and subclavian veins is exposed. At the angle of junction of these veins the dissection is begun. The omo-hyoid is divided at its tendinous part, the two bellies of this muscle being drawn out of the way and serving, in a measure, as retractors.

We have cleaned out the supraclavicular fossa in 67 cases. Cancer was found in the tissues removed 23 times, or in 34 per cent of these cases. In 30 cases there was no cancer, and in 14 it is still uncertain whether the supraclavicular region was involved or not, because the tissues have not yet been exhaustively studied. Only those familiar with the work can understand the amount of labor implied in the statement that a given mass of the fat does not contain a cancer alveolus.

Not all of the 67 operations above the clavicle were what we call primary, for 14 of them were performed subsequent to the original operation and because supraclavicular glands could be palpated. Living and apparently free from metastases three or more years after the primary operation are four cases whose necks were involved and cleaned out secondarily. Of these, two are living and well more than four years after the primary operation, and three and three and a half years respectively after the operation on the neck. In one of these latter cases I considered the prognosis desperately

bad at both the infra- and supraclavicular operations. At the first operation the cancer had infiltrated the axillary fat diffusely, and could with difficulty be separated from the subclavian vein; at the second operation the same desperate state of affairs was encountered in the neck. A piece of the clavicle was exsected and a very thorough operation performed. We were pleased to find at the second operation that there was no evidence of recurrence in the axilla. It is now more than three years since the neck operation was done, and the patient, whom I saw a few days ago, feels perfectly well, and has no signs of recurrence or metastasis.

When these statistics were prepared the neck operation, as we call it, had been performed primarily 53 times; in 12 of these cases, about 23 per cent, the supraclavicular tissues were involved.

It is to be hoped that others have reached the conclusion that we should not abandon as hopeless all cases of breast cancer in which there is supraclavicular involvement. Indeed, I fail to see why the neck involvement in itself is more serious than the axillary. The neck can be cleaned out just as thoroughly as the axilla. Dr. Bloodgood, Instructor in Surgery, has, on the necks of two patients, done as many as three operations each for glandular involvement, and apparently saved his patients. The additional operations were for glands above and below the region of the neck first attacked. In one of these cases he entered the mediastinum from above to remove a cancerous gland, and had to excise a piece of the innominate vein. Dr. H. W. Cushing, my house-surgeon, has in three instances cleaned out the anterior mediastinum on one side for recurrent cancer. It is likely, I think, that we shall in the near future remove the mediastinal contents at some of our primary operations.

As I have said, we clean out or strip the supraclavicular fossa with very few exceptions at the primary operation. It is unwise to postpone this operation until enlarged glands can be palpated above the clavicle, for we not infrequently find in the tissues removed cancerous glands too small or too deeply imbedded in fat to have been felt through the skin, and often a large gland or several glands at the junction of the subclavian and internal jugular veins which were too deeply buried behind the clavicle to have been detected before the operation. The axilla offers no criterion from which we might draw inferences as to the condition of the supraclavicular fossa. Sometimes, with an axilla which is involved chiefly in the lower or arm part, and apparently not at all in the upper or subclavian part, we have a neck involved solely at the junction of the internal jugular and subclavian veins. This state of things was present in a recent case in which I had a considerable personal interest. The patient was a young lady whom I was very loath to disfigure, and as the higher or subclavian part of the axilla

seemed free from cancer, and nothing suggestive of cancer could be detected in the neck, I said to my assistants that I would not touch the neck. But upon examining the breast and axillary contents removed, I was so much impressed with the unusual malignancy of the little cancer that I returned to the table and stripped the supraclavicular fossa. Several cancerous glands were found at the junction of the great veins and internal to the inferior thyroid artery.

It sometimes happens, on the other hand, that the neck is not involved although the axilla is a solid mass of cancer. Hence, it would appear that for the present our rule should be, *operate on the neck in every case.* The neck operation should not be postponed for a second act. It can never again be done so well as at the first operation, when the axilla is open, the subclavian vein fully exposed, and the clavicle free. In the main operation we have made some changes. We remove the minor as well as the major pectoral muscle, dividing the insertion of the major and then its origin and the origin of the minor, before we expose the subclavian vein. This vein is first exposed at its inner part, and the axilla stripped of its contents and its anterior wall at one time from within outward and from above downward as heretofore. We have made no change in the skin incision; indeed, I should hardly know how to do so; one must always circumscribe the mass to be excised with a circular or an oval incision, and must make additional cuts to expose axillary and jugular veins. Tumors should never be harpooned, nor should pieces ever be excised from malignant tumors for diagnostic purpose. Think of the danger of rapid dissemination of the growth from injecting cancer of the tongue with cocaine and then snipping off a piece of the tumor with scissors.

In studying the published histories of cases of malignant tumors, particularly sarcoma, I have been impressed with the great number of cases in which general dissemination of the neoplasm has seemed to follow swiftly upon exploratory incisions.

Breast tumors should not be incised on the operating-table prior to their removal. The surgeon must learn to recognize malignant tumors not only with the microscope, but also with his naked eye and fingers.

There are, of course, tumors which cannot be diagnosticated until an incision has been made into them or into the axilla. For example, a large benign, cyst may have a tiny cancerous spot in its wall, or a very slowly growing carcinoma may be sharply defined or even encapsulated and resemble on palpation a benign tumor. If the surgeon cannot, in a given case, make a diagnosis prior to operation, an exploration of the axilla might help him; if still in doubt, he should excise the breast or, at least, give the tumor

a wide berth. If then, on incision, the tumor proved to be malignant, the complete operation should be performed immediately.

Operating for the cure of cancer is a very great labor. We never attempt more breast cancers than one in a day. The operation, including the toilet of the wound and the grafting, requires from two to four hours with highly trained and skilful assistants; it is performed in an absolutely bloodless manner, and the patient, in consequence, suffers not at all from shock. Three days ago, for example, in a three-hour operation, the patient's pulse ranged from 66 to 70 throughout the entire operation. At all operations a record of the pulse is kept on what we call the *ether chart,* introduced by my house-surgeon, Dr. Cushing. We remove rather more skin than we did originally, and in all cases we graft the wound immediately. Grafts are cut from the patient's thigh as large as or larger than one's hand. A single one of these large grafts may be enough to cover the raw surface. In cutting a graft of this kind the skin is made tense by a board which the operator slides along the thigh just in front of a large amputating knife or catlin. The graft is spread, raw side up, on a piece of rubber tissue, and from the latter is readily transferred to the breast wound. It is finally covered with silver foil and tissue paper, and need not be looked at again for two or more weeks. The silver foil makes an ideal dressing for grafts, very much better than anything else we know of. For several years we hesitated to graft these cases at once, fearing to prolong the operation another half-hour; but now we have become accustomed to these very long operations, and have learned that they may safely be continued almost indefinitely if they are bloodless and if the anaesthetic is properly given.

Results of Operations for Breast Cancer at The Johns Hopkins Hospital from June, 1889, to April, 1898

One hundred and thirty-three cases have been operated upon; seventy-six of these more than three years ago. There have been thirteen (9 per cent) local and twenty-two (16 per cent) regionary recurrences. Of the seventy-six cases operated upon three or more years ago, thirty-one (41 per cent) are living without local recurrence or signs of metastases; ten died more than three years after the operation, and one as late as five and a half years thereafter; of these ten, one had a local recurrence. Forty cases, therefore (52 per cent) lived more than three years without signs of local or regionary recurence. Some of the ten cases which died may have had at three years signs of metastases; I cannot make a positive statement as to this point. Thirty-five cases (46 per cent) died within three years of the operation, but only seven of these with local recurrence.

DISCUSSION

Dr. Halsted.—Such a very hearty and apparently unanimous indorsement by this society of our views as to the treatment of breast cancer is indeed most gratifying to me.

I had hoped that Dr. Matas might offer some explanation of the marvellously good results which he obtained by the older methods in the treatment of breast cancer; for we all, undoubtedly, have known surgeons of large experience who have stated that they had not cured a single case of breast cancer.

No, Dr. Nancrede, I have no personal knowledge of any case of carcinoma of the breast in a patient so young as nineteen years, nor do I know of any reliable reports in modern times of cases in young girls.

In answer to Dr. Park, endotheliomata are alveolar sarcomata, but we cannot say that all alveolar sarcomata are endotheliomata. One often finds strands or columns of endothelial cells resembling cancer in fibro- and myxosarcomata and in the mixed tumors of connective-tissue origin in the parotid gland and testicle. There are some who, like Hausemann, of the Virchow School, regard endotheliomata as carcinomata, for, prior to the studies of Waldeyer and Thiersch, Virchow held that all carcinomata were of connective-tissue origin.

As to the spontaneous disappearance of carcinomata and the inquiries of Dr. Park and Dr. Gaston, I can testify to the almost complete, if not complete, disappearance within the past three months of a recurrent cancer of considerable dimensions which I have been carefully watching for three years, and which, for twelve or thirteen years, has been gradually if almost imperceptibly growing. In this case there are extensive and unmistakable metastases in the axillary glands and sternum which have not disappeared. It was after an attack of "grip" (possibly a streptococcus "sore throat") that the breast cancer first showed signs of diminution in size.

An epithelioma of the face, observed by Dr. Finney and several of our assistants in the dispensary, disappeared after a severe attack of facial erysipelas. I might mention in this connection that large mycosis fungoides tumors vanished, for a time at least, after a very severe attack of erysipelas induced by inoculation.

I am very much interested to hear that Dr. Richardson has operated upon so many cases of cancer of the breast prior to the involvement of the axillary glands. Exclusive of four of the adenocarcinomata which I have just described in detail, we have met with only two cases of breast cancer in which, at the time of operation, the axillary glands were not involved.

I wish it were possible to enlighten the people, as well as the physicians in all parts of this country, on the subject of breast cancer, and make them realize how important it is that the operation should be done as soon as the tumor is discoverable—there are so many physicians who still consider operation for cancer useless, and some who believe that they can dissipate the new growth by nostrums. Patients frequently come to us of their own accord against the will of the doctor.

THE RESULTS OF RADICAL OPERATIONS FOR THE CURE OF CANCER OF THE BREAST[1]

It is especially true of mammary cancer that the surgeon interested in furnishing the best statistics may in perfectly honorable ways provide them. The most conscientious man may refuse to operate upon any but favorable cases, and, by performing an incomplete operation, exclude from his list of complete operations such bad ones as he finds himself operating upon. Or the pathologist on whom he relies may classify as carcinoma the tumors which on microscopic examination show dangerous spots, *i. e.*, a few epithelial cells here and there escaping into the stroma.

But you will concede that little notion of the value of an operative procedure can be gained unless some attempt be made to exclude or consider apart cancers so far advanced that, however radical the operation, only a portion of the disease can be removed.

The Results

As affecting the ultimate result, the variety of the cancer, the time elapsed since its appearance, the degree of outlying involvement, the activity of the gland (lactation, age of patient), the thoroughness of the operation, are important factors.

There will not be time in this discussion to consider in detail each of these influences. It is the particular wish of the Society, as I have understood it, to learn the results obtained by the modern, so-called complete, operation for the cure of cancer of the breast, and it affords me the greatest pleasure to express anew my obligations to Dr. Bloodgood for his efficiency and inexhaustible zeal in collating facts year after year for so many years, and to thank Mr. Schapiro for his invaluable assistance in tabulating from many points of view our results. I am exceedingly indebted, also, to the many physicians who have ardently assisted us in the search for data concerning their patients.

I ask your attention to the tables. According to the plan of operation the cases have been divided into five groups: of these, only three concern

[1] Presented before the American Surgical Association, Washington, D. C., May 8, 1907.

Tr. Am. Surg. Ass., Phila., 1907, xxv, 61-79. (Reprinted.)

Also: Ann. Surg., Phila., 1907, xlvi, 1-19.

us today. In Group I are the cases in which, at the one occasion, the complete subclavian and neck operations were performed; in Group II the cases in which, at the first operation, the complete pectoral or subclavian, and at a second the supraclavicular or neck part was performed; in Group III those in which only the complete pectoral operation was done, the neck being unexplored. The small letters, *a, b, c, d,* indicate, approximately, degrees of axillary involvement; *a,* signifying that the base or lowest part only of the axilla was implicated; *b,* involvement of the midaxilla as well as of the base; *c,* involvement, in addition, of the highest glands of the surgical axilla; and *d,* that the subclavian vein was involved or intimately adherent to the glands.

In the tables here presented are included only the cases in which nothing less than the complete subclavicular operation was done and only those operated upon three or more years prior to the last news received of them. Excluding 65 cases in which, necessarily, an incomplete operation was performed there remain for study of the cases operated upon at The Johns Hopkins Hospital, 232. The result in 18 of these we have been unable to determine. In calculating the percentage of cures, untraced cases should be figured as dead of the disease.

In Tables II and III the ultimate results are considered in relation to the glandular involvement, and in Table II in relation also to the particular operation performed. In 64 of the 232 cases glandular involvement was not discovered; nevertheless, in 15 of these (23.4 per cent) there was metastasis or recurrence of some sort sooner or later; in 6, metastasis three years after operation. It is interesting to note how late the metastasis occurred in these cases with undetected axillary involvement; another argument for wide operating. Forty-five of the 64 (or 70 per cent) of the cases with undemonstrated glandular involvement are tabulated as cured, and 51 of the 64 (or 80 per cent) were free for three years from signs of the disease. We must bear in mind, however, that surely in some, and probably in many, if not in most, of the axillae recorded as negative there was disease.

TABLE I

CARCINOMA OF THE BREAST. PATHOLOGICAL VARIETIES

	Cases	Cured	Per cent
Cancer cysts	6	2(1?)	33.3
Adenocarcinoma	32	24	75.0
Medullary carcinoma	25	12	48.0
Circumscribed scirrhus	28	13	46.4
Small infiltrating scirrhus	80	30	35.5
Large infiltrating scirrhus	39	8	20.5
Total	210	89	

Symbols Used in the Tables

Complete axillary operation:
- Group I, Supraclavicular glands removed at 1st oper.
- Group II, Supraclavicular glands removed secondarily.
- Group III, Supraclavicular glands not removed.

Letters *a, b, c, d* indicate degree of axillary involvement:

a, Base of axilla only.
b, Base and midaxilla.
c, Base, midaxilla and apex.
d, Veins intimately adherent.

TABLE II

Carcinoma of the Breast. Cases Operated Upon Three or More Years Prior to Last News of Them

Ultimate result as affected by degree of axillary involvement	Axilla only involved				Axilla and neck involved				Totals
		b	*c*	Total	*b*	*c*	*d*	Total	
Cured, living 1906-7	6	..	..	6	..	..	1	1	7
Cured, living in 1905	3	3	..	6	..	..	..	..	6
Cured, dead of other causes 3 years +	..	2	2	4	1	1	..	2	6
Cured, dead of other causes 3 years —	..	..	1	1	..	..	..	..	1
Actual cures	9	5	3	17	1	1	1	3	20
Well 3 years, metastasis later	1	4	..	5	..	1	1	2	7
Cured 3 years and over	10	9	3	22	1	2	2	5	27
Dead, local recurrence	1	3	3	7	1	6	1	8	15
Dead, regionary recurrence	5	4	6	15	2	7	2	11	26
Dead, internal metastasis	5	13	5	23	1	9	5	15	38
Cases not cured	11	20	14	45	4	22	8	34	79
Cured 3-year cases	10	9	3	22	1	2	2	5	27
Postoperative deaths	..	..	..	3	..	..	..	1	4
Untraced	..	..	..	11	..	..	..	3	14
No data as to extent of axillary involvement.	..	..	..	43	..	..	..	1	44
	21	29	17	124	5	24	10	44	168

TABLE III

CARCINOMA OF THE BREAST. CASES OPERATED UPON THREE OR MORE YEARS PRIOR TO LAST NEWS OF THEM

Ultimate result as affected by axillary and neck involvement	Glands of axilla and neck negative				Glands of axilla positive, glands of neck negative				Glands of axilla and neck positive			Totals
	I	II	III	Total	I	II	III	Total	I	II	Total	
Cured, living: heard from 1906-1907	4	1	20	25	4	..	5	9	..	1	1	35
Cured, living: heard from 1905	4	2	7	13	4	..	3	7	..	..	..	20
Cured, dead of other cause more than 3 years postoperation	4	..	3	7	4	..	3	7	1	1	2	16
Cured, dead of other cause less than 3 years postoperation	..	..	..	..	1	..	3	4	..	..	..	4
Cases actually cured	12	3	30	45	13	..	14	27	1	2	3	75
Cured 3 years after operation, metastasis later	1	..	5	6	3	..	4	7	1	..	1	14
Cases cured not less than three years	13	3	35	51	16	..	18	34	2	2	4	89
Dead, local recurrence	..	..	..	..	5	..	11	16	6	4	10	26
Dead, regionary recurrence	1	..	3	4	13	1	7	21	5	5	10	35
Dead, internal metastasis	2	..	3	5	15	1	23	39	14	2	16	60
Cases that have not been cured	3	..	6	9	33	2	41	76	25	11	36	121
Cases cured 3 years and more, as above	13	3	35	51	16	..	18	34	2	2	4	89
	16	3	41	60	49	2	59	110	27	13	40	210
Postoperative mortality	..	..	..	..	2	..	1	3	1	..	1	4
Untraced	..	..	4	4	3	..	8	11	3	..	3	18
	16	3	45	64	54	2	68	124	31	13	44	232

TABLE IV

CARCINOMA OF THE BREAST. STUDY OF CURED 5-YEAR CASES (TO JANUARY, 1907)

	Cases	P. O. D. and lost	No. of cases	Cured, living	Cured, dead	Metast. after 5 years	Total	Per cent
Group I	96	8	88	13	6	5	24	27.27
Group II	16	..	16	3	1	1	5	31.25
Group III	92	5	87	23	3	4	30	34.48
	204	13	191	39	10	10	59	30.89

Of 110 cases with axillary involvement and negative neck, 27 cases, or 24.5 per cent, are cured for periods ranging from sixteen to three years. Adding 11 untraced cases with axillary involvement to the 110 in which the result is definitely known, reduces the percentage of cures in this category to 22.4 per cent.

The fact that in this country, at least, a number of the leading surgeons of the generation prior to mine made the pronouncement that they had not in their lifetime cured a single case of breast cancer, notwithstanding the fact that they removed the entire breast, a liberal piece of skin, and, after a fashion, some axillary glands, is strong presumptive evidence that in almost every instance the cancer, as then recognized, had entered the lymphatic vessels. As proof of this is our observation that, even in the cases with microscopically negative axilla, and notwithstanding our extensive operation, there is death from metastasis in 23.4 per cent.

Fortunately, we no longer need the proof which our figures so unmistakably give, that the slightest delay is dangerous, and that, other things being equal, the prognosis is quite good in the early stage of breast cancer, two in three being cured; and bad, three in four succumbing, when the axillary glands are demonstrably involved. We find encouragement for our operative and laboratory labors and to increased endeavor quite as great from the relatively poor results obtained in the advanced cases as from the more favorable outcome in the cases in which no involvement of lymphatic glands was detected.

The neck operation was done in 101 cases primarily, and in 18 secondarily. In 113 of the 232 cases the supraclavicular operation was omitted. In 44 patients the glands of the neck, as well as of the axilla, were involved. Three of these, or 7 per cent, were, it seems, definitely cured. One is still living, twelve and one-half years since the operation; a second lived six years and died of diabetes; a third, three and three-quarter years without

signs of return, died of acute pneumonia; and in a fourth, after three years of apparent freedom, the disease remanifested itself. We have reason to be quite certain that there was also involvement in some of the necks reported as negative.

Before accepting the statement of anyone that he has cured a case of breast cancer with neck involvement, incontrovertible proof should be demanded. I confess that even if the microscopic findings were confirmed by an able pathologist, I should still feel that an error might have occurred, for example, in the labelling of the specimen. The naked-eye diagnosis of the surgeon should count for nothing unless he is a sound pathologist, and the macroscopic findings are specifically detailed. Inflammation may produce appearances in lymphatic glands quite indistinguishable macroscopically from carcinoma, whether medullary or scirrhus. If the deposit is described as sharply outlined against the more normal portions of the gland, particularly if cortical, the observation deserves consideration. We should demand as further proof of cure, in these positive neck cases, that the patient live at least five years after the operation, or negative autopsy findings, a year, or perhaps even two years thereafter. With these stipulations fulfilled, I should still be skeptical as to the cure. Cancer was diagnosticated, both macroscopically and microscopically, in the three cases of cure claimed by us. But, even without the proof which we offer, it is, I think, incumbent upon the surgeon to perform in many cases the supraclavicular operation. He should surely perform it, barring, of course, special contraindications (1) in all cases with palpable, operable neck involvement; (2) when the apex of the surgical axilla is involved. When midaxillary involvement is demonstrable at the operation apical implication is almost certain, and hence (3) in these cases also the neck should be typically cleaned of its lymphatics, as high, at the very least, as the bifurcation of the carotid.

We find ourselves for the past two years again performing the neck operation in most cases. We omit it in hopeless cases, in most "duct cancers," and in some carcinomata of emphatically adenomatous type in which the axilla at operation is not macroscopically involved.

To determine the relation of supraclavicular to subclavicular involvement detailed observations at the operating table with special reference to this point must be made; and almost endless laboratory work is necessary. To be able to assert with any degree of positiveness that the axilla and neck are negative involves infinite toil. The findings at operation should be recorded on charts designed especially for this purpose; and a laboratory enthusiast of a rare type is indispensable.

For the greater convenience of the reader the following summary is given. Of the 232 cases considered, 18 remain untraced. Of the 210 traced cases, we accept as *cured:*

35 cases reported living in 1906-7		16.6 per cent of 210
20 cases reported living in 1905		9.5 per cent of 210
16 cases known to have died of causes other than carcinoma of the breast three or more years after the operation		7.9 per cent of 210
4 cases dead of other disease less than three years after operation, in which the cure was demonstrated by autopsy		1.9 per cent of 210
Total cured	75 cases = 32.3 per cent of 232;	and 35.9 per cent of 210

In 14 cases metastasis appeared after three years, in one instance manifesting itself as late as eight years, and in two instances more than six years after the operation. Thus, 89 cases (42.3 per cent of 210, and 38.3 per cent of 232) were apparently cured for three or more years.

In the 210 traced cases the condition of the axilla and neck, as regards glandular involvement, was as follows:

		Cured	Per cent	Cured 3 years	Per cent
Axilla and neck negative	60 cases	45	= 75	51	= 85
Axilla positive, neck negative	110 cases	27	= 24.5	34	= 31
Axilla and neck positive	40 cases	3	= 7.5	4	= 10
Total	210				

The Mortality

Four of the 232 patients died in the hospital, a mortality of 1.7 per cent. The group apportionment of the deaths is as follows:

Group I	in 101 cases, 3 deaths = 3.00 per cent	2.5 per cent
Group II	in 18 cases, 0 deaths = 0.00 per cent	
Group III	in 113 cases, 1 death = 0.88 per cent	

Thus, it would seem, without particulars, that the neck operations were responsible for the greater mortality, Groups I and II yielding a 2½ per cent death rate, and Group III, in which the neck operation was omitted, a mortality of hardly 1 per cent. But two of the deaths in the neck cases

were clearly due to an avoidable error, quite independent of the operation. These two patients, operated upon just twenty-four hours apart, were convalescing normally until the first dressing, which was made in both cases the same day and hour, respectively, eight and nine days after the operation. Within a few hours of the dressing each patient had a chill, with high temperature. The skin grafts and wound, which in each had a perfectly normal appearance at the time of the dressing, rapidly acquired the features so characteristic of general infection. Excluding these two cases, the mortality in the patients with neck operation becomes 0.99 per cent, only a shade more than in the cases with axillary operations alone, in which it is 0.88 per cent.

Recurrence and Metastasis

We know little of what is going on under the skin along the fascial planes even when our attention is drawn to the disease by the appearance, here and there, of cutaneous or subcutaneous nodules at long distance from the primary tumor. I recall distinctly one case, and less distinctly one or two other cases, of intestinal and peritonaeal cancer in which general metastasis was believed, erroneously, I think, to have occurred by way of the blood-vessels, although the only evidence of metastasis was numerous subcutaneous and fewer cutaneous nodules, situated chiefly over the abdomen and confined altogether to the trunk, or to the trunk and its immediate vicinity. Although it undoubtedly occurs, I am not sure that I have observed, from breast cancer, metastasis which seemed definitely to have been conveyed by way of the blood vessels; and my views as to the dissemination of carcinoma of the breast accord so fully with Handley's [2] that I may, in justice to him, who has formulated and expressed them so well, quote now and again from his admirable chapters. "In showing that cancer cells in blood excite thrombosis, and that the thrombus as it organizes usually destroys or renders them harmless, Goldmann and Schmidt seem to have established a fact of primary importance, and one which is strongly opposed to the embolic theory as applied to carcinoma." We believe, with Handley, that cancer of the breast, in spreading centrifugally, preserves in the main continuity with the original growth, and before involving the viscera may become widely diffused along surface planes.

Statistics obtained from many sources indicate that bone metastasis in cases of breast cancer occur, as phrased by Handley, very rarely in areas not actually invaded by the subcutaneous nodules. As is well known, the sternum, ribs, spinal column, femur, and humerus, and, perhaps, also the

[2] Handley. Cancer of the Breast and Its Operative Treatment. London, 1907 (W. Sampson).

skull, are the bones most frequently attacked in cases of breast cancer. Distal to the elbow and knee the bones escape, except in rare instances, cancerous invasion. We have in our cases no record of bone involvement below these joints. "The liability of a bone to cancerous metastasis increases with its proximity to the site of the primary growth." The illustration on the next page graphically represents the coincidence of the areas liable, respectively, to bone metastases and to subcutaneous nodules.

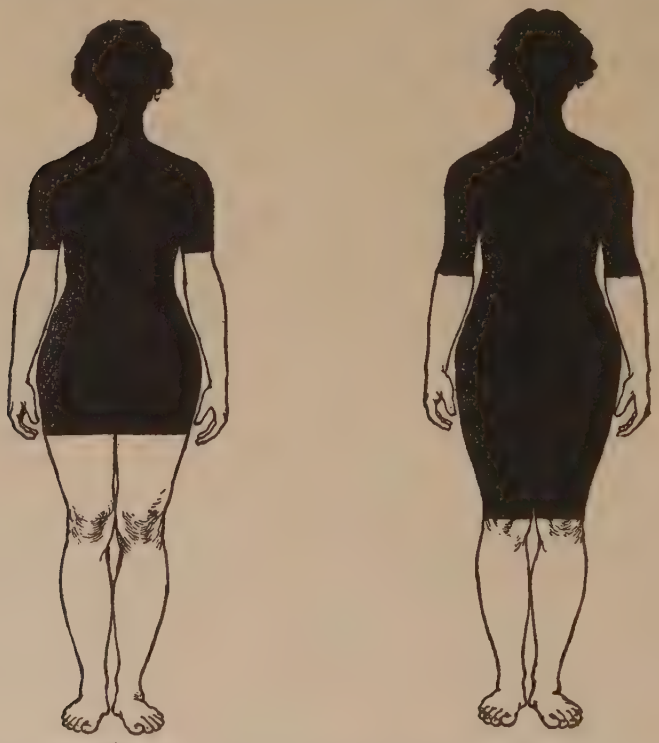


FIG. 58.—Diagrams showing the maximal distribution areas of subcutaneous nodules and of metastases in bone in cases of mammary carcinoma. The black area in *A* is the area liable to subcutaneous nodules, that in *B* is the area within which bone metastases occur. (After Handley.)

In that metastases occur both in general and in the special case only in bones which lie in the area invaded by subcutaneous nodules there is signified a relationship between the two, "between the bone deposits and the subcutaneous nodules." The dissemination probably takes place by way of the lymphatics—not by the blood vessels—and the disease holds together without important interruptions. It permeates to the bone rather than

metastasizes to it, and, by way of the lymphatics, along fascial planes. Much evidence has been adduced by others, and most convincingly by Handley, to indicate that the centrifugal spread of breast cancer takes place primarily in the plane of the deep fascia. If the bones are invaded by way of the lymphatic plexus of the deep fascia the first attack should fall on the spot nearest the deep fascial lymphatics—nearest the surface; in the case of the femur, at the great trochanter; of the humerus, at or below the insertion of the deltoid; and such seems actually to be the case.[3]

There is then a definite, more or less interrupted or quite uninterrupted, connection between the original focus and all the outlying deposits of cancer, "the centrifugal spread annexing by continuity a very large area in some cases." Thus the liver may be invaded by way of the deep fascia, the linea alba, and round ligament,[3] "the brain by the lymphatics accompanying the middle meningeal artery."

Cancer Cysts

At some other time we may consider in detail the cancer cysts, but at present can only speak of the difficulty in recognizing them and the hopelessness of the prognosis if their character is not suspected by the surgeon at the operating table. "By the surgeon," I say, for unless the operator espies the hardly discernible changes in the delicate wall of the cyst it will not occur to him that it is worth while to submit a piece for immediate examination by the pathologist. If he is able to recognize the barely perceptible thickening, the slight lack of lustre, the faintest possible difference in color and in texture, he will probably make the diagnosis without microscopic assistance. Blood-stained fluid should arouse one's suspicions, but there may be no staining of the cyst-content. Every portion of the wall should be scrutinized, particularly the base of the not infrequent papilloma. The prognosis is quite hopeless if the diagnosis is not made at the operating table. I failed to make it in the first case and possibly in the second, although I have the impression that my suspicions were aroused in the second case, operated upon many years ago. In all the clinically undiagnosticated cases the nature of the cyst was soon discovered by the microscope, and in all, more or less promptly, a second operation performed; but, alas, performed in vain. The cases saved are only those in which, at the operating table, the correct diagnosis was made. Further proof of the necessity of making the correct diagnosis at the time of operating is not needed. The prognosis in these cases of cancer cyst, the earliest recognizable cancers, perhaps, is

[3] Handley furnishes convincing proof that the liver may be invaded by way of the linea alba and round ligament.

excellent if the nature of the disease is perceived at the table; hopeless, so far as our statistics are concerned, if it is not. Do we require more definite proof than this, that the first operation is responsible for the inefficacy of the second? The precise means by which the first renders the speedily following second operation futile, is not, perhaps, altogether clear. The partial operation (the first) certainly disseminates the cancer, which the complete operation (the second) in the primarily diagnosticated cases of cancer cyst has not, in our experience, done. Furthermore, dissemination takes place probably by routes not already travelled by the cancer cells and not commonly travelled by them in the early unoperated cases. Probably by these unusual routes the disease soon reaches parts outside the domain of the operation and so escapes eradication.

The Diagnosis

It is not expected of me in this report to touch upon the diagnosis of breast cancer; furthermore, it is considered a trite subject—one to which little can be contributed. But for me, interest in the diagnosis of difficult cases increases, and with it the conviction that really something remains to be said and done. It well repays the experienced surgeon to spend perhaps an hour in the examination of certain breasts. The diagnosis has usually and unfortunately been exceedingly simple. But women are now presenting themselves more promptly for examination, realizing that a cure of breast cancer is not only possible, but, if operated upon early, quite probable. Hence, the surgeon is seeing smaller and still smaller tumors—cancers which give not one of the cardinal signs. About as difficult a case as any, excepting, of course, the adenoma in a transitional stage, is a tiny retromammary adenocarcinoma, or a colloid carcinoma, in a breast covered with one or more inches of fat. If in such a case there should be no shortening whatever of the trabeculae, the diagnosis could hardly be made. The fat, on pressure being elastic, and the tumor so deep, the differential diagnosis from cyst might not be possible. But, given even very slight shortening of the trabeculae from tumor to skin, this fact might be determinable by making both breasts take the widest possible excursions on the chest wall under the skin. The faintest conceivable trace of a difference on the two sides, in a minor pectoral crease, for example, may suffice for the diagnosis. Raising the skin over the tumor with the fingers, to ascertain the relative length of the trabeculae, is too crude a method, and in no case serviceable unless the tiny growth is directly under or close to the nipple; for, if the test applied in this way gives a positive result, there is so much shortening of the trabeculae that the slightest displacement of the breast would reveal

it. I have occasionally noticed that of my assistants perhaps one or two will see a trace of asymmetry in the skin tug on extreme displacement which the others are wholly unable to make out; and I have more than once in just such case of difference of opinion performed the complete operation for very small, deep-seated cancers, without exploratory incision. Frequently there is no sign, but this almost imperceptible suggestion of pull, which, when the faintest possible, is, of course, elicited by dislocation in one direction only. This sign, however slight, is all that is needed for the diagnosis. Practice in the examination of such cases, doing one's utmost to get such evidence, is highly rewarding. Any breast, if displaced far enough, will, of course, tug, in a way, on the skin; it is only under the most accurate control with the other breast that its significance in difficult cases may be estimated. It will seem to some that I am wasting many words to tell what every surgeon knows; but to me, at least, the extreme possibilities of this test were not fully realized a decade, perhaps, ago, and each year, I believe, it develops a little in refinement. The ability to determine elasticity, the elasticity of a small cyst, as hard, almost, as bone, comes to some earlier than to others; but to me, if it has come at all, it came only with long practice. In the breast a difficulty arises from the fact that a tense cyst makes itself felt such considerable distance in the surrounding mammary tissue, particularly if the breast is very fibrous. A nodule seemingly as large as a pea to palpation may be caused by a cyst no larger than a small pin-head, and a cyst almost microscopic may, by the pressure which it exerts in the dense fibrous tissue of the breast, occasion a definitely palpable, quite circumscribed hardness. It should impress the uninitiated to witness the ability of the demonstrator to diagnosticate with the fingers through considerable fibrous tissue these hardly visible cysts yielding, on puncture, the tiniest fraction of a drop. The general nodular feel of a fibrous mamma in situ or on a tray depends largely upon small to tiny foci of parenchyma, which are most readily recognized by the finger when a little fluid (the minutest particle suffices) is retained under tension.

The firm, circumscribed pressure exercised in the effort to determine the elasticity of a tumor occasionally ruptures, I believe, the capsule of a fat lobule. In three instances, while making this test, a peculiar sensation has been communicated to the fingers, which I attributed, in the first instance, and with considerable apprehension, to rupture of a cystic portion of a colloid cancer which I believed to be under examination. The cause of this perfectly unmistakable sensation, which must, one feels, be accompanied by a nonaudible sound (onomatopoetically, geräusch), we have been unable definitely to determine. It is due to the crushing or rupture of something, certainly not of a cyst, and I have noted this sign only in fat people.

The size of the breast, relative to that of the other side, should, of course, be determined; but it is important to note most carefully the relative amount of uninvolved mammary gland remaining—relative to the amount in the other breast and to the size of the new growth.

Given a carcinoma, say one-half or one-quarter as large as the palm of the hand, if this tumor has grown not at all or little at the expense of the breast—and this is ascertained by making the comparison just advised—the prognosis is relatively good; for the tumor in such case is quite surely of a definitely adenomatous type, and not of the scirrhus variety.

There can be little doubt, in my opinion, that a scirrhus cancer represents only a part of what has existed. The struggle against the cancer cells, resulting in fibrous-tissue production, is quite surely not always futile, and when the minute foci of cancer epithelium have been destroyed, the new fibrous tissue may, in part, be absorbed also. Thus the scirrhus disease may be active and metastasis take place a long time before the visible or palpable tumor is developed. It would undoubtedly be possible for the expert to discover of the scirrhus growth earlier stages than he encounters, but unfortunately the tumor must first be recognized by the patient, and a scirrhus cancer large enough to attract her attention has quite surely already gone afield. Our problem, therefore, is to discover these tumors before the afflicted one can do so. Shall we let women know that a dangerous process may be going on which they cannot detect, and keep them constantly in a state of apprehension, or shall we encourage them to seek "expert" advice, which may be insufficiently expert, and expose them to the annoyance of repeated and useless examinations, each of which for only a brief period, if at all, would bring a measure of reassurance?

The Operation

Though the area of disease extend from cranium to knee, breast cancer in the broad sense is a local affection, and there comes to the surgeon an encouragement to greater endeavor with the cognition that the metastases to bone, to pleura, to liver are probably parts of the whole, and that the involvements are almost invariably by process of lymphatic permeation, and not embolic by way of the blood. If extension, the most rapid, takes place beneath the skin along the fascial planes, we must remove not only a very large amount of skin and a much larger area of subcutaneous fat and fascia, but also strip the sheaths from the upper part of the rectus, the serratus magnus, the subscapularis, and, at times, from parts of the latissimus dorsi and the teres major. Both pectoral muscles are, of course, removed.

A part of the chest wall should, I believe, be excised in certain cases, the surgeon bearing in mind always that he is dealing with lymphatic, and not

blood, metastases, and that the slightest inattention to detail, or attempts to hasten convalescence by such plastic operations as are feasible only when a restricted amount of skin is removed, may sacrifice his patient to the disease.

It must be our endeavor to trace more definitely the routes travelled in the metastases to bone, particularly to the humerus, for it is even possible in case of involvement of this bone that amputation of the shoulder-joint, plus a proper removal of the soft parts, might eradicate the disease. So, too, it is conceivable that ultimately, when our knowledge of the lymphatics traversed in cases of femur involvement becomes sufficiently exact, amputation at the hip-joint may seem indicated. The operation might with advantage be considered in greater detail, and I hope in the near future to have the opportunity to do so.

As to the closure of the wound, I should not care to say, "Beware of the man with the plastic operation." The surgeon should familiarize himself with the principle of the one or two particular plastic operations which make the best use in the simplest manner of any redundant or easily glideable skin, as of the axillary flap, that he may be prepared in any case to utilize in combination with skin grafting such features as seem applicable. But to attempt to close the breast wound more or less regularly by any plastic method is hazardous, and, in my opinion, to be vigorously discountenanced. The oval flap, whatever the direction of its long axis, removes, so far as the cure of the disease is concerned, a circle of skin whose diameter is not greater than the short axis of the oval. I still believe in the removal of a very large circle of skin, and indorse the remark of my ex-house surgeon, Dr. Follis, that the operator whose duty it is to close the wound should not be intrusted with the planning of the skin incision. Skin-grafting, well done, consumes few minutes; as a method, it adds little, if at all, to the period of convalescence, except so far as very early arm movements are concerned, and nothing to the mortality. I grant that to cut the grafts well, much practice is necessary, and the skill acquired by some is so great that I intrust this part of the procedure to the dextrous house surgeon. Thiersch grafts from the thigh are commonly cut as large as a good-sized hand. One such graft may be sufficient to cover the defect; more than two large grafts are not often required. The silver-foil dressing for the grafts, used at The Johns Hopkins Hospital for so many years, seems quite ideal.

Occasionally, and happily with increasing frequency, an incision for diagnostic purposes has to be made. Great care should be exercised to make these exploratory cuts no deeper than is absolutely essential. Very rarely is it necessary to carry the knife *into* a cancer, for on exposure of the subcutaneous fat the tell-tale drawing of the fibrous tissue is revealed; sometimes the fat must be cut into for a little distance. If the growth is not malignant the incision should usually pass through it.

Caustics

I am indubitably convinced that the local and regionary recurrences after incomplete operations, which come, as a rule, with amazing rapidity when the knife has been used, are, to say the least, relatively late in making their appearance when chemical or actual cauterization has been employed. I have several times had occasion to operate upon cancers which had been vigorously and repeatedly treated with caustics, and to note the comparatively admirable condition, the freedom from cancer permeation, of the surrounding tissues and of the axilla; whereas, after incomplete operations with the knife the local manifestations of recurrence were almost invariably deplorable and the prognosis, of course, invariably hopeless.

It was my practice at one time in making the exploration in doubtful cases to excise a portion of the breast tumor with the Paquelin cautery to prevent the wound inoculation which I feared might take place if the knife were used. The excision of a specimen for macroscopic or microscopic examination is never resorted to except just before operation. If the actual cautery for any reason is not used, the wound is immediately cauterized with carbolic acid. All incomplete operations for cancer should, when feasible, be made with the Paquelin or actual cautery.[4] The Paquelin is ideal for the removal of cutaneous nevi, particularly of the melanotic variety. I doubt if any melanotic tumor of the skin should be removed with the knife.

Cancerous Axillary Glands, with Nondemonstrable Cancer of the Mamma

I have twice seen extensive carcinomatous involvement of the axilla due to mammary cancer, which latter in neither instance became palpable or demonstrable for a considerable period after the axillary glands had attained conspicuous dimensions. In each case the "axillary tumors" had been removed, in one of them a year before, and in the other perhaps two years prior to my first examination, which, though made in the most careful manner, failed to find the slightest evidence of cancer of either breast. In the course of a few months thereafter the mammary disease manifested itself in both patients.

A third patient was operated upon, for enlarged glands of the axilla, about two and one-half years before she consulted me concerning the local axillary recurrence of the disease, and more especially to be relieved of severe neural-

[4] I was greatly pleased to note, during a recent visit to Rochester, Minnesota, that Drs. William and Charles Mayo make extensive use of the actual cautery in operations upon cancers incurable by the knife, and to have them indorse the view, so long maintained by me, that there is relative immunity from local metastasis with the employment of the cautery.

gic pains in the arms and legs. In this woman I found a large mass of axillary glands, which proved to be cancerous; but nothing in the breast except a quite definite parchment-like induration at the base of the nipple, which was retracted not at all, or merely to a barely appreciable degree. With performance of the complete breast operation the pains in the extremities, which distressed her greatly, vanished.

Disseminated Pains, which Would Seem to be Caused Occasionally by the Toxins Generated in the Course of the Growth of Cancer

Distressing pains in the knees, the legs, the back, the arms, so severe and so located as to suggest cancerous involvement of the vertebrae, have in two cases operated upon by me at The Johns Hopkins Hospital disappeared on removal of the growth, which in one instance was large, ulcerous and foul-smelling; in the other (the case cited at the end of the preceding paragraph) consisted merely of a large mass of glands in the axilla.

Reactionary Oedema in Mammary Cancer.—Quite recently I was privileged to see a condition of board-like oedema, limited, in a general way, to the pectoral region of one side. There was no definitely appreciable abnormality of the mamma other than the oedema, in the area of which it was included; otherwise, not until perhaps six months after the first manifestation of this oedema was there the least evidence of neoplastic disease of the breast. Then, as, in my experience, is usually the case in the presence of extensive and great oedema of reaction, the cancer made very rapid strides.

DEVELOPMENTS IN THE SKIN-GRAFTING OPERATION FOR CANCER OF THE BREAST[1]

It has been my custom every year or two to request our patients operated on for mammary cancer and living in or near Baltimore to come on certain mornings to the surgical clinic of The Johns Hopkins University in order that we may observe the ultimate result, particularly with reference to the function of the arm.

For about sixteen years our practice has been to cover the fresh defect, made as small as feasible in various ways, with large Thiersch grafts. The available skin was tucked high into the armpit in order to cover the axillary vessels, to obliterate the dead space under the clavicle, and to elevate to the highest possible point the axillary fornix.

The tip of the axillary flap was usually cut away. Notwithstanding this precaution, a little necrosis of the badly nourished flap was not infrequently observed, and as a consequence there occurred an occasional but rare infection of the wound, and in the location where it might be productive of great harm, namely, on the confines of the subclavicular dead space which we had attempted to obliterate in the ordinary way, by tucking up the flap and holding it in place with soft packs of gauze. Infection of this space not only delayed healing but also prevented primary union of the tucked-in skin to the wall of the thorax, to the subclavius muscle and to the subclavian and axillary vessels. In such event the healing of the dead space was by granulation, and the resulting cicatricial tissue in the axillary fornix caused or accentuated the swelling of the extremity and, more or less, prevented the free movements of the arm. Infection, furthermore, influenced unfavorably the healing of the skin-grafts.

In plastic operations the danger of the necrosis is, of course, greater than in the skin-grafting operations, because in the former the circulation of the flaps is still further impaired both by the added incisions and by the increased traction which is exercised in the effort to cover the raw surface with skin. It is expecting too much of a thin flap deprived of its fat and submitted to the pressure of a gauze pack sufficient to keep the flap in place and to obliterate the axillary dead space, always to maintain its circulation to the very edge.

[1] Presented before the American Surgical Association, Montreal, Canada, May 29-31, 1912.

Tr. Am. Surg. Ass., Phila., 1912, xxx, 287-293. (Reprinted.)
Also: J. Am. M. Ass., Chicago, 1913, lx, 416-418. (Reprinted.)

With few exceptions the patients have been well satisfied with the resulting usefulness of the arm. Such restrictions of movement as they suffered from did not prevent them from dressing their hair and performing household work. But in the majority of cases, on abducting the arm beyond 90 degrees, a point would ultimately be reached, as the elbow approached the head, when a band of skin and connective tissue was seen to tug between the chest wall and the shoulder. I have repeatedly said to my patients that if this band were divided and the resulting defect covered by a skin-graft the desired motion would be permitted unless prohibited by changes in the shoulder-joint which might in time have taken place. In no instance, however, has the patient considered herself sufficiently handicapped by the restriction in the movement to care to submit to the proposed operation.

For some years we have been trying to remedy the defects of the method and have succeeded in such measure that I consider it worth while to describe the modifications which our original operation has undergone.

The incision down the arm, made shorter and shorter, was finally abandoned. The vertical cut to the clavicle is made as short as feasible and when considerable skin has been removed above is omitted.

Not infrequently the only incision of the skin is the circular one surrounding the tumor, but as a rule the one or the other of the vertical incisions has been made. By means of the two vertical incisions, one above and one below, the dissection of the axilla is, of course, facilitated. Thus the triangular flap has been definitely abolished.

The skin of the outer flap between the two vertical incisions is utilized primarily to cover completely, without any tension whatever, and redundantly the vessels of the axilla. The edge of this flap is stitched by interrupted, buried sutures of very fine silk to the fascia just below the first rib in such way that the skin partly envelops the large vessels. Then. along the entire circumference of the wound, the free edge of the skin is sutured to the underlying structures of the chest wall, the wound being made as small as desirable in the process of closure, and tension on the upper or axillary part of the outer flap assiduously avoided. Considerable traction may, however, be exercised on the mesial flap and on the lower portion of the outer flap. The form and position of the resulting defect may be seen for a given case in the accompanying illustrations. Whatever the size and shape of the grafted defect, it should usually extend to the top of the axillary fornix. Thus the thoracic or inner wall of the apex of the axilla is always lined with skin-grafts.

The arm is adducted 90 or more degrees during the stitching of the wound and is not included in the dressing. Only the gentlest pressure is exerted by the bandage holding in place the gauze handkerchiefs which should be

evenly applied with solicitous care. Particularly to be avoided is the placing of a wedge of gauze in the axillary fornix, and the using of this as a kind of fulcrum to be bridged over by the adducted arm. Drainage is unnecessary.

Movements of the arm as free as possible are encouraged after the second day. These may be executed without apprehension if the wound is closed in the manner indicated.

Reasons for Skin-Grafting in Operations for Cancer of the Breast

1. An almost unlimited amount of skin may be removed. From the observations made at the surgical clinic of The Johns Hopkins University it would seem that the results have been better in the cases in which larger areas of the skin were removed. According to the statistics of our clinic as prepared by Dr. Joseph C. Bloodgood, it would seem that of the various operators those have had the best results who make a practice of giving the tumor the widest berth in making the incision of the skin. These surgeons may, however, perform a more thorough operation in other respects.

Undoubtedly we often remove an unnecessarily large amount of skin; but the patient is not in the least inconvenienced thereby, nor is the operation delayed on this account, for the reason that the defect is covered with Thiersch grafts, on the healing of which one can rely almost absolutely. Nothing is gained, therefore, by saving skin which, either because it is too close to the cancer or by reason of impairment of its circulation, is questionable.

Whatever a given surgeon's views may be in general as to the amount of skin which should be removed for the cure of mammary cancer, he is certain at times to be confronted with cases which clearly demand excision over a very wide area. In such event he will, I believe, find the procedure which I have advocated of definite value.

It is better to remove too much skin than too little, for the mistake of excising an insufficient quantity is quite fatal to the patient's chances of recovery. Whether the grafted area is large or small, the time required for the healing of the wound and the range of motion permitted to the arm are the same.

2. Skin-grafts present a definite obstacle to the dissemination of carcinomatous metastases. I have seen cutaneous recurrences along the margins of the grafted area spreading with great rapidity in the skin, extend over the opposite breast, to the back and over the abdomen to the pelvis without involvement of the grafted area except by encroachment at the edges. In one such case in the course of two years, the complete mammary operation having been done on both sides and the supraclavicular operation

FIG. 1.—Six weeks after operation. To show the great freedom of motion.

FIG. 2.—Six weeks after operation. Arm at right angle to body. Shows subclavicular fold of redundant skin.

on the right side, the entire skin of the front of the thorax, of the right and part of the left side of the abdomen and of the right back nearly to the middle line was removed and the denuded area grafted, and yet at no point did the disease invade the grafted area except here and there for a few lines at the margins.

In certain cases, as is well known, there is a particular and, it may be, early tendency of the cancer to disseminate itself in the skin and to develop the cancer *en cuirasse*. I formerly regarded the prognosis in these cases as quite hopeless, but my experience in comparatively recent years encourages me to feel that there may be a much better chance for some of these patients than is generally believed. In the case referred to immediately above in which from repeated operations the woman had become actually flayed over the entire front, sides and part of the back of the thorax and over the abdomen down to the crest of the right ilium, there was at autopsy[2] no microscopic evidence of cancer in the glands or viscera or elsewhere. Dr. Winternitz, however, who made a most painstaking post mortem examination, reported that microscopically one of the mesenteric glands and a piece of tissue removed from the cicatricial tissue of the right supraclavicular region showed involvement. At the operation above the right clavicle, performed about one year before the patient's death, it was observed that the carcinoma had invaded the tissues outside of the lymphatic glands and was extending into the sheaths of the nerve trunks of the brachial plexus. It was surprising, we thought, that the recurrence in this region had not manifested itself promptly.

It occurred to me that it might be well in certain cases evidencing this special tendency to skin metastasis—to regionary recurrence confined to the skin—to surround the denuded and grafted area, more or less completely and as might seem indicated, by a kind of moat with the hope that by such expedient the disease, should it continue to spread in the skin, might be confined to the region intervening between the two grafted areas—between the main wound and the moat placed at some distance from it.

The moat is formed by the excision of a narrow strip of skin with its underlying fat and loose fascia. Possibly the gap caused by the mere incision through the skin down to the sheaths of the muscles might suffice.

If the moat is made at the time of the primary operation the grafts should be of the Thiersch variety and covered with silver-foil. If the grafting of the moat has for any reason to be deferred—to be made secondarily on a granulating surface—the Reverdin grafts are preferable.

[2] The patient died from a general infection contracted a few days after her temporary discharge from the hospital and as the result, probably, of a very fatiguing railway journey.

Silver-foil is not a suitable dressing for grafts placed on a granulating or infected surface; a piece of gutta-percha tissue riddled with holes like a porous plaster or, as suggested and practised by Dr. Staige Davis, a rubber mesh, or some other permeable nonadherable covering should be employed. But when the surface is not infected and it is desirable to leave the dressing undisturbed for a week or more, as after operations for mammary cancer, the silver-foil has proved at our clinic to be an admirable dressing for the grafts.

3. Recurrences in the deeper planes may be promptly detected under the thin, grafted skin. These should be burnt away, down to the pleura if necessary, with the actual cautery. When the defect is covered by normal skin, as in an incomplete or in a plastic operation, not only is the underlying recurrence concealed for an indefinite period, but also the transferred skin with its lymphatic channels brought from a distance, when it becomes involved, aids in the dissemination of the disease.

We disapprove of the clever suggestion to cover the defect by the transfer of the opposite breast; less perhaps on account of the more obvious objections to it than because with this procedure recurrences in the denuded area would be so deeply covered that they could not be discovered promptly, or, perhaps, not until the transplanted breast had become involved.

One may be compelled to resort to a plastic operation when the tumor has extended so far into the axilla as to make it necessary to provide skin from elsewhere to assist in covering the axillary vessels. Under these circumstances a more or less vertical cut up the neck on the opposite side has sufficed to release the skin which seemed available.

4. The inner or thoracic wall of the axilla being lined to the extreme apex with grafts, the skin of the outer flap may be utilized, *in redundant fashion,* for covering the axillary vessels, for obliterating the subclavian dead space and for elevating the axillary fornix.

A DIAGNOSTIC SIGN OF GELATINOUS CARCINOMA OF THE BREAST[1]

I recall having examined within the past twelve years five cases of colloid carcinoma of the breast—cases in which the colloidal portion (or portions) of the new growth was large enough and near enough to the surface to be palpable. In all but one of these there was conveyed to the finger on testing for elasticity a peculiar sensation which in the first instance made me apprehensive lest I had ruptured a possible capsule of the nodule, although there was no apparent alteration in its size or shape.

I find it difficult to describe the tactile impression. It might be defined as a delicate swish or crush of a jelly-like structure under tension, with the suggestion of a delicate bursting.

In no instance have I obtained the sensation twice in the same case, nor has any assistant felt it on making the examination before or after mine. Presumably there is lost to the physical properties of the tumor a something essential to the production of the sign.

In Case I, a large lobulated colloid carcinoma, the sign was not observed.

In Case 2, the right mamma had been amputated for a carcinoma which in spots was colloidal. A year or two later this patient returned with what seemed to be a like growth of the opposite breast. It was faintly lobulated and in places seemed to be elastic. While I was testing, with moderate force, the resiliency of one of the nodules, the described sensation under the finger was noted. I was alarmed, thinking that I must have ruptured some portion of the tumor, and urged the patient to permit operation at once. She did not consent, and returned to her home in another city. I wrote to her afterward, but was never given the opportunity to determine the nature of the growth.

The third patient presented herself a year or two later. Nothing was observed at the first examination of her mammary tumor to recall the previous case. But on the operating table, in the course of the examination under ether, the faint but unmistakable "swish" was felt. The carcinoma proved to be of the colloid variety, and there was no macroscopic evidence of damage having been done to the tissues by the examination.

It was, perhaps, five or six years after this experience that Dr. Finney invited me one day to come to his clinic to examine the breast of a patient under ether on whom he was about to operate. The tumor, about the size

[1] J. Am. M. Ass., Chicago, 1915, lxiv, 1653. (Reprinted.)

of a guinea-egg, was, as I recall it, not unquestionably elastic. Trying to determine this particular point and while I was exercising, perhaps, rather more force than usual, the identical swishing or crushing sensation was reproduced at my finger tips. Instantly the two previous experiences were recalled to mind, and I tentatively predicted colloid carcinoma; and such the tumor proved to be.

The fifth patient, referred by Dr. Branson of Philadelphia, consulted me a few weeks ago. The tumor was unmistakably a carcinoma, hard and infiltrating. There was a suggestion of elasticity near the surface. The patient was admitted to The Johns Hopkins Hospital, April 12th. On the operating table, five days later, in the course of the examination under ether, the crush or swish, the characteristic (I do not venture to say pathognomonic) sensation was felt over the elastic spot. The diagnosis of colloid carcinoma was made with considerable confidence, and it proved to be correct. The deeper part of the neoplasm was a typical scirrhus; surmounting this was an ovoid nodule, about 3 cm. in diameter, of colloid carcinoma.

In none of the cases was there recognizable any macroscopic evidence of traumatism.

Inasmuch as this sign manifested, I might say obtruded, itself unsought in the four successive cases, it is not possibly a creation of my fancy.

In each instance the unmistakable swish was a surprise. Not once had I in mind the possibility of colloid cancer until the peculiar sensation was felt.

I have not experienced this tactile impression nor have I tested for it in colloid goitre.

I shall be interested to learn if other surgeons have made this observation.

ELUSIVE MOBILITY OF THE BREAST IN A CASE OF RETROMAMMARY CYST[1]

Surgical No. 36939. Large healthy woman, aet. 43. Admitted to The Johns Hopkins Hospital, May 4, 1915.

About four weeks before admission the patient noticed, quite accidentally, on palpation, an abnormal hardness in the upper half of the right breast. She could not recall having had the slightest pain in either mammary gland.

Examination.—Both breasts were rather voluminous, the right slightly larger than the left. On inspection there was a faint suggestion of fullness about the middle of the upper hemisphere of the right mamma. On palpation a fairly well defined area of induration, measuring approximately 9 x 7 cm., was found. The lower margin of the mass corresponded quite accurately to the horizontal nipple-line. The tumor was very hard and seemed to be inelastic. There was no retraction of the nipple, no evidence of shortening of the subcutaneous trabeculae on widest excursions of the breast and, in brief, none of the signs of carcinoma. Glandular tissue of considerable thickness apparently intervened between the skin and the hard mass, the margins of which seemed finely roseate.

There was, however, one remarkable manifestation. Several times in the course of the examination, at the moments when the tumor's elasticity was being tested by the exercise of particularly firm pressure, the breast, suddenly, would make an elusive glide outwards under my fingers. This was so surprising that I commented on it to my assistants. At the final examination, on the operating table the same thing occurred, and my associate, Dr. Heuer, who assisted at the operation, remarked that he, too, had been surprised while making his examination to note this abnormal slipping of the breast on the chest wall. As a possible explanation of the phenomenon I suggested retromammary cyst. This the tumor proved to be.

Glandular tissue, a centimeter or more in thickness, was cut through before the cyst was punctured. The posterior wall of the cyst was very thin, perhaps one quarter of a millimeter thick, and protruded hernia-like from the under surface of the breast. The precise size and shape of the projecting part of the evacuated cyst could not well be determined. We surmised that it had been hemispherical in shape and about the size of an English walnut.

As lesser grades of this significant motion would probably be overlooked, its manifestation may prove to be not so very uncommon in cases of retromammary cyst.

Solid tumors projecting from the under-surface of the breast might, conceivably, in the absence of adhesions or exudative reaction give the same, roller-like glide.

[1] Johns Hopkins Hosp. Bull., Balt., 1915, xxvi, 350. (Reprinted.)

THE SWELLING OF THE ARM AFTER OPERATIONS FOR CANCER OF THE BREAST—*ELEPHANTIASIS CHIRURGICA*—ITS CAUSE AND PREVENTION[1]

Nearly 40 years ago, probably in 1882, I had occasion to excise thoroughly the lymphatic glands from both groins of a young man, and there resulted a swelling of the scrotum greater than I have ever seen as a consequence of this operation. Much perturbed, I consulted Dr. Charles E. McBurney who at this time was interested in the management of similar cases, and together, for a year or more, we attempted with inconsiderable success to reduce, chiefly by strapping with adhesive plaster, the distressing dimensions of the swelling. Two and a half years ago this patient, to whose misfortune I had repeatedly referred in my clinics at The Johns Hopkins Hospital and whom I had not seen for about 38 years, came to Baltimore to consult me in regard to another matter. The scrotum, although much reduced in size, was conspicuously large and incommodious. Especially interesting was the account which he gave, in response to careful questioning, of recurrent attacks of redness and increased swelling accompanied by digestive and constitutional disturbances. These attacks, not infrequently ushered in by chills and fever, were milder and less frequent than formerly but still occurred at least once or twice in the course of a year.

Oedema following operative blocking of the lymphatics is most frequently observed after the radical operation for cancer of the breast. For many years I was unable to account for the fact that in some instances a year or two or more after this operation and without return of the disease there would occur, suddenly or perhaps slowly, a swelling, occasionally very great, of the upper extremity. Consultations on the subject with surgeons in this country and abroad were not very helpful, the opinion frequently vouchsafed being that swelling due to obstruction of lymphatics was hard and appeared late, whereas the swelling which followed blocking of the veins was relatively soft and supervened promptly. In the spring of 1914 the Director of one of the greatest clinics in Germany expressed to me the opinion that the typical operations upon the axilla in cases of carcinoma of the breast were unnecessarily radical, and that in order to forestall the excessive swelling of the arm which followed in such a large percentage of the patients he was stripping out the axillary contents in a manner much

[1] Johns Hopkins Hosp. Bull., Balt., 1921, xxxii, 309-313. (Reprinted.)

less thorough. Since adopting this modification he was confident that swollen arms were less frequent in his clinic and that the percentage of recurrence had not been increased thereby.

For many years I have entertained the view that, although blocking of the lymphatics and occasionally also of the veins was the underlying factor, infection played a conspicuous part in the determination of the amount of the swelling and the time of its manifestation. The facts observed in the following case sustain this opinion most convincingly:

A woman (Surg. No. 41383) on whom I had performed at The Johns Hopkins Hospital our radical operation for mammary carcinoma on November 18, 1916, consulted me on May 24, 1920, in regard to a swelling of her arm which had appeared suddenly (within three or four days) three years and three months after the removal of the breast. There had been no swelling whatever of the arm at any time subsequent to the operation prior to an "attack" in February, 1920, in the course of her convalescence from influenza. This attack, as she terms it, was ushered in by nausea, a chill and high fever. The arm promptly began to swell and there appeared "redness in streaks" from the shoulder to the wrist; in a few days the redness was diffuse and the swelling of the arm had become distressingly great; the hand resembled a "boxing glove," and pressure on it with the fingers produced "deep pits." In eight or ten days the redness had vanished and the swelling was rapidly decreasing. During the three months prior to this her second admission to The Johns Hopkins Hospital there had been a less rapid reduction in the size of the affected (left) limb, which about the middle of the arm measured in circumference 9.5 cm. more than the other, and at the middle of the forearm, 3.5 cm. more. No glands were palpable above the clavicle, and there seemed to be no abnormal fullness or resistance below it. In the skin at the outer-upper edge of the grafted area there was recurrence of the carcinoma—two nodules, not ulcerated, one about the size of a filbert, the other smaller than a split pea.

The immediate cause of the swelling was undoubtedly the local infection, for during the three years and three months prior to this there had been nothing to indicate a blocking of the lymph channels.

Eight days after the second admission (June 1, 1920), the patient was operated upon by Dr. Mont Reid, our resident surgeon. The second and a part of the third portion of the axillary vein were found to be completely occluded by the new growth, which was continuous with the larger of the two cancerous nodules in the skin. The entire axillary vein and the recurrent growth were excised in one piece, the disease being given a wide berth. On examination of the specimen it seemed quite clear that the vein had been invaded from without, and had probably been occluded long before the attack of infection. After this operation the swelling rapidly subsided and in the course of two months the arm had almost regained its normal dimensions.

In this case, as in a number of others observed in our clinic, the occlusion of the axillary vein plus the excision of the axillary lymphatics had not been followed by any swelling of the arm.

A few months ago I interviewed a patient (Surg. No. 17659) who each year for the sixteen years following an operation by me at The Johns Hopkins Hospital for cancer of the breast has had one or two and occasionally three or four attacks of redness and swelling of the arm on the operated side. The first symptoms, malaise and nausea, were quickly followed in the severe attacks by a chill and fever and then by slight redness and increased swelling of the arm. The arm of this patient was observed to be swollen a few days after the operation, the swelling being attributed in part to the excision of the axillary lymphatics, but in great measure to a slight infection of the wound along the incision onto the arm.

At that early period, and indeed until perhaps after the introduction of our present operation, about eleven years ago, we believed that, quite independent of infection, swelling of the arm might be expected after the radical operation for mammary cancer.

The initial account of the operation for cancer of the breast which bears my name lies buried in the second volume of the Reports of The Johns Hopkins Hospital (1891) under the title "The Treatment of Wounds with Especial Reference to the Value of the Blood Clot in the Management of Dead Spaces," [2] *and is known only to a few.*

Nine years have now elapsed since the publication of my paper on "Developments in the Skin-Grafting Operation for Cancer of the Breast," [3] in which a modified incision and radical changes in the manner of closing the wound were advocated; but I was not then able to offer an explanation altogether satisfactory to myself of the fact that the swelling of the arm which not infrequently followed our original procedure became almost immediately after the adoption of the modifications described in the latter paper a complication of rare occurrence.

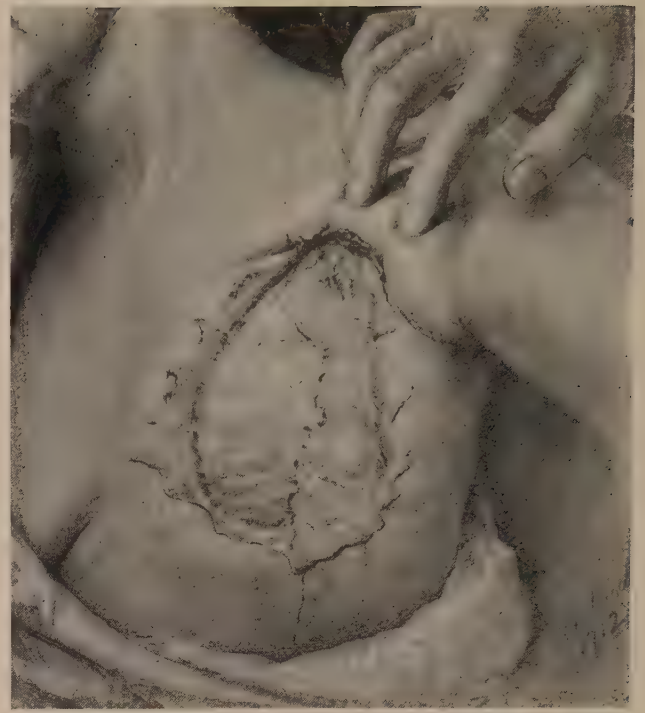
Our operation of today is the one which with few exceptions has been employed at The Johns Hopkins Hospital for the past eleven years. Prior to its adoption we had not infrequently observed that extreme abduction of the arm was prevented by a cicatricial, cuticular band in line with the scar of the incision onto the arm. In no case, however, did the patient consider herself sufficiently incommoded by the restriction of movement in this direction to accede to the proposition that the tugging band be divided and the defect covered by skin grafting.

The problem thus thrust upon us was readily solved: the incision down the arm, made shorter and shorter, was soon abandoned altogether, and

[2] W. S. Halsted, The Treatment of Wounds with Especial Reference to the Value of the Blood Clot in the Management of Dead Spaces. The Johns Hopkins Hospital Reports, 1891, ii, p. 255.

[3] W. S. Halsted, Developments in the Skin-Grafting Operation for Cancer of the Breast. Jour. Amer. Med. Assn., 1913, lx, p. 416.

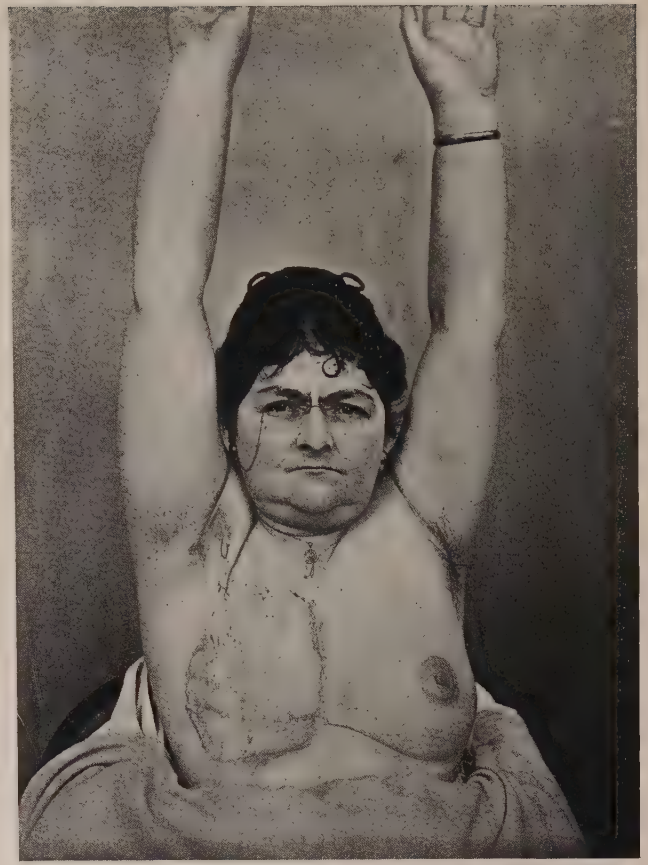
1.—The redundant axillary skin is drawn up by the fingers. The skin has been stitched to the underlying muscles at the margin of the area to be grafted, the apex of which corresponds to the lower border of the first rib. Reproduced with permission of the *Journal of the American Medical Association.*



2.—The defect has been covered with Ollier-Thiersch grafts. The redundant axillary skin retracted by the fingers, as in the preceding illustration. Reproduced with permission of the *Journal of the American Medical Association.*

1.—S. N. 29519. Operation by Dr. Halsted March 30, 1912. Reproduced with permission of the *Journal of the American Medical Association.*

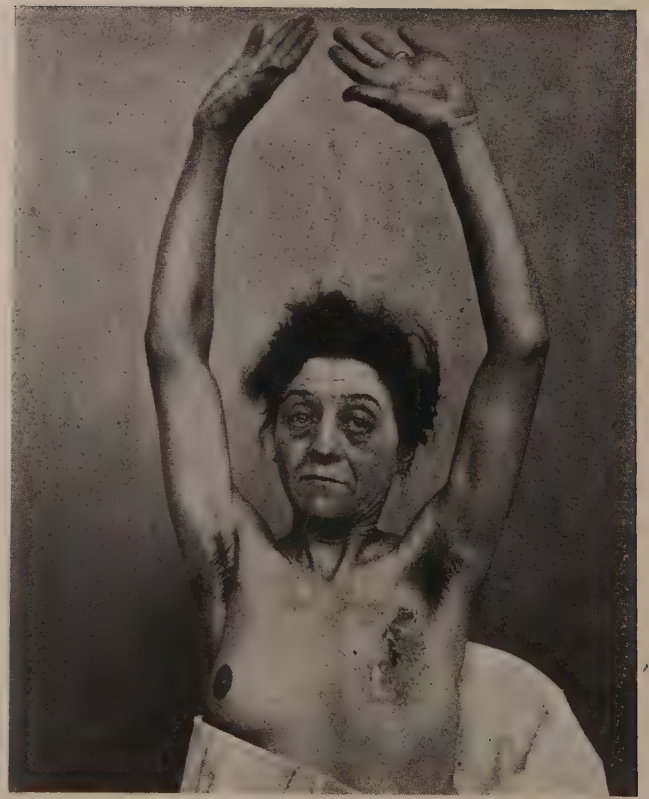
2.—S. N. 29519. Three days after operation. The denuded area covered by skin grafts. Silver-foil (high lights) on the skin along the inner and upper margins of the wound. Reproduced with permission of the *Journal of the American Medical Association.*



1.—S. N. 51869. Operation by Dr. Reid September 3, 1920. Huge fungating carcinoma; skin metastases; subclavicular, axillary, and regional oedema; swollen arm, forearm and hand. Photograph taken nine months after operation. The swelling of the arm was not increased by the operation. Note the great size of the grafted area and the redundant skin in the axilla.

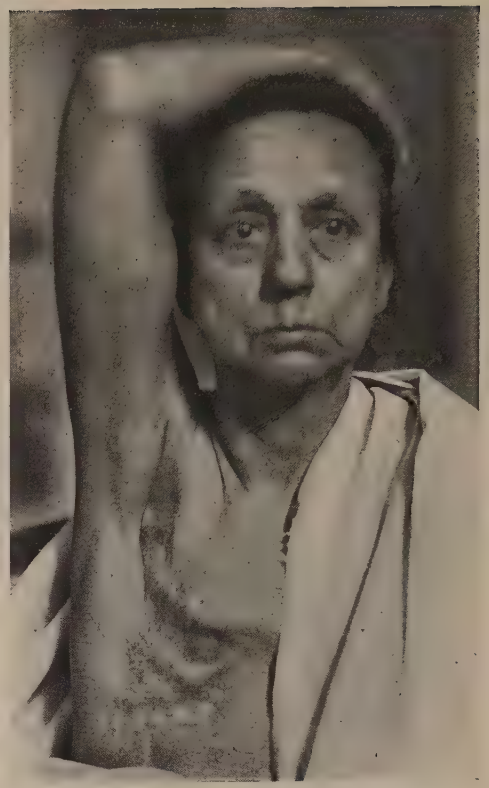
2.—S. N. 49379. Operation by Dr. Reid September 19, 1919. Photograph taken April 1, 1921.

1.—S. N. 49808. Operation by Dr. Heuer November 21, 1919. Photograph taken January 18, 1921.



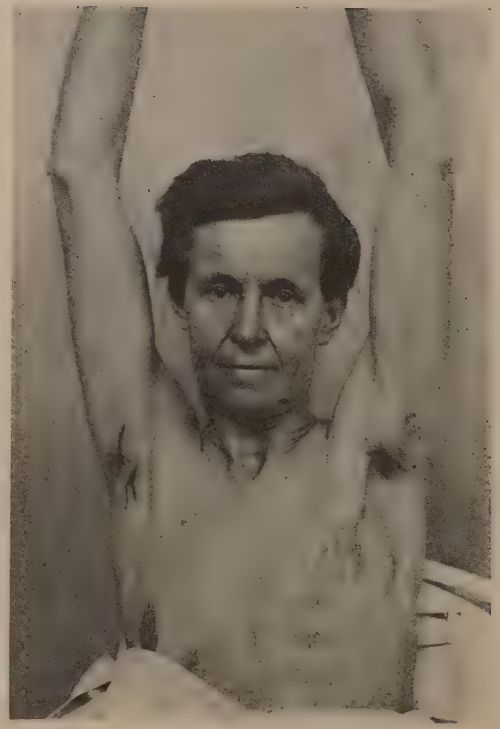
2.—S. N. 37632. Operation by Dr. Dandy August 10, 1915. Photograph taken Feb. 27, 1920.

1.—S. N. 46656. Operation by Dr. Reid September 27, 1918. Photograph taken February 27, 1920.



2.—S. N. 40261. Operation by Dr. Dandy July 12, 1916. Photograph taken March 8, 1918. A graft placed almost at the very top of the axillary fornix.

1.—S. N. 42198. Operation by Dr. Heuer February 19, 1917. Photograph taken March 8, 1918.



2.—S. N. 45095. Operation by Dr. Follis March 1, 1918. Photograph taken February 27, 1920.

the skin edge at the upper margin of the wound was tacked with fine silk sutures to the first intercostal muscle and its fascia in such manner as to raise the axillary fornix to the highest desirable point (*vid.* Plate LXI, 1). Thus the possibility of tug on any part of the skin or scar was eliminated.

No effort was made to approximate the cut edges of the skin at the upper third or perhaps upper half of the denuded area; on the contrary, the flaps, if so they may be called, were pressed away from the wound's centre—the outer flap upwards and outwards, the inner flap upwards and inwards—and stitched to the underlying muscles of the thoracic wall. Thus there was secured for the infraclavicular and axillary regions a superabundance of skin, and entire freedom of arm movements in all directions was assured. Furthermore, by the tacking of the margin of the flap close up to and sometimes even under the subclavian vessels (*vid.* Plates LXI, LXII, LXIII, LXIV, LXV, and LXVI), there could be no dead space below the clavicle such as results in plastic operations from the attempt to approximate the margins of the flaps—the dead space whose arc, formed by clavicle, first intercostal muscle, and first rib, is subtended by the more or less tightly drawn tegmen. The lower half or more of the denuded area was to a limited extent covered by gently drawing the free margin of the skin towards the centre of the wound and tacking it to the underlying muscles, although the size of the grafted area is of little practical consequence to the patient, and only slightly more time is consumed in covering with the large grafts a greater than a lesser surface.

More was accomplished by this new method than had been anticipated, for not only was the normal range of arm movements secured but there resulted other benefits unforeseen. Swollen arms of dimensions sufficient to distress or annoy the patient were no longer observed, marginal necroses rarely occurred, and the grafts took throughout with few exceptions.

Now it is within the experience of every surgeon, especially of those who employ plastic methods to cover the defect, that frequently marginal necroses of the flaps occur and occasionally sloughings of considerable dimensions, and that it is usually in these cases that the swelling of the arm is most pronounced. Attendant upon the necrosis there is infection, and inflammatory reaction in varying degree, and the greater the reaction the greater in general the swelling of the arm immediate and ultimate.

Moreover, there are, as I have said, cases in which months or even years after the operation on the breast the arm becomes swollen from a cause other than the recurrence of the carcinoma.

Recurrent carcinoma being excluded, may not the later swelling of the arm have the same cause, whatever that may be, as that which appears soon after the operation? What is the cause? What the explanation of the fact

that after the radical operation, the world over, for cancer of the breast the arm so frequently swells and sometimes to such degree that amputation has been proposed and indeed made for relief?

Why is it, furthermore, that a modification in our method of closure of the wound, the operative details otherwise being essentially unchanged, should so strikingly affect the result as regards the swelling of the arm?

It is not from observations made in our clinic alone but from the testimony of surgeons and radiologists elsewhere that we have been led to conclude that swelling of the arm follows the plastic operations in greater proportion and in more pronounced form than is seen in the cases treated by skin grafting. And, moreover, in the skin grafting operations, which with us trace back to 1895, conspicuously swollen arms became almost a thing of the past after the method of pressing back the flaps at the upper part of the wound, and stitching their edges to the underlying intercostal muscles was adopted.

Something must, therefore, have been superimposed upon the mere clearing out of the axilla in the ordinary as well as in the extraordinary plastic operations, and in the operations at The Johns Hopkins Hospital which antedated our modified procedure, to account for the so frequent swelling of the arm.

In addition to the evidence furnished by our clinical experience, we have the testimony of the many who have studied the causes of elephantiasis filariosa that blocking of the lymphatic glands and vessels is not of itself sufficient to account for the oedema, at least in its pronounced forms.

Dr. F. L. Reichert, who with the assistance of Dr. C. Y. Bidgood has made for me in the Hunterian laboratory, during the past winter, experiments bearing on this subject, has thus far been unable to produce oedema in the legs of dogs by the mere severing of veins and lymphatics. In these amputations all the tissues of the thigh were severed except the femoral artery and vein, the main nerve trunks and the bone; then the divided parts were carefully reunited by stitching. For 7 or 8 days there would be slight swelling of the leg below the line of suture. On subsidence of this temporary swelling the femoral vein (the only undivided vein) would be ligated. No demonstrable increase in the size of the leg occurred after this ligation. Thus in one week or less the lymphaticovenous circulation was reestablished through the line of suture—through the scar. We have it in mind to make the ligation also of the artery at various periods after the amputation.[4]

[4] Since the above was written Dr. Reichert has informed me that he has already carried out the suggestion to ligate the artery as well as the vein about a week after the amputation made in the described manner. Neither gangrene nor swelling followed the ligation of these vessels. Thus, within a week of the time of the amputation of the thigh the arterial and venous circulations had been so well restored

Attempts are being made by us to determine the relative susceptibility to infection of the two hind legs—of the operated and the normal one. We conjecture that the leg operated upon may prove to be more susceptible to infection than the other and also that an abnormal amount of swelling may follow a successful inoculation of the obstructed leg.

These experiments call to mind an interesting paragraph by W. G. MacCallum on "Inflammation in Tissues Separated from Connection with the Central Nervous System."[5]

An attempt was made to study the cause of inflammation in tissues separated from connection with the central nervous system as compared with that in normal tissues. The mere section of the nerves going to an organ or limb is insufficient, for nerve fibrils accompany the blood vessels. To overcome this an extremity was amputated completely and replaced by anastomosing the blood vessels and bringing together muscles and skin. Inflammatory irritants applied symmetrically to the intact, and to the amputated limb of the dog resulted in the production of quite the same phenomena of inflammation on both sides. The reddening due to the dilatation of the blood vessels was perhaps slightly more intense on the amputated side than in the intact limb. Evidently, the control of the central nervous system is not at all necessary for the development of inflammatory changes.

May the swelling of the arm after the radical operation for cancer of the breast be prevented? The study of our cases operated upon by the newer method has brought out the fact that excision of the axillary and supraclavicular glands plus resection of the subclavian and axillary veins is rarely followed by noticeable swelling of the arm. On the other hand, we do not deny that obstruction of these lymphatic and venous channels might conceivably alone, without infection, suffice occasionally to produce a moderate amount of oedema. But it is assuredly impossible to assert in any case that infection has played no part in the causation of the swollen arm.

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through the line of union of the divided tissues as to make possible the ligation of the femoral artery and vein without causing any appreciable swelling or anaemia of the limb. It remains to note the effect of ligation of the artery with unoccluded vein, and also to determine the earliest period after the amputation at which these vessels can safely be occluded. It is to me a surprising fact that in so short a time the arterial, venous and perhaps lymphatic circulations can be reestablished through a scar. We have it in mind to inject the vessels of the animals so treated with shadow-casting materials and thus, if possible, study with the X-ray the fine channels through which the new circulation is carried on. Conceivably an amputated limb might be reinstated as is the case with severed fingers, ears and noses. One must at least make the experiment. These experimental observations tend to strengthen my belief that swelling of the arm is unlikely to be caused by the mere excision of the axillary lymphatics. It would seem to be quite certain that another factor is needed, namely, infection.

[5] Proceedings of the Soc. for Exp. Biol. and Med., 1910-11, p. 180.

It is unnecessary to stress further the importance of discarding operative methods which clearly predispose to infection, quite aside from the fact that these methods—the plastic ones—tend to deter the surgeon from sacrificing a sufficient amount of skin or, if perchance enough skin has been excised, to increase the danger of swelling and of restricting the range of movement of the arm. In the plastic operations, the wide dissections of the skin extending sometimes to the spinal column, over and under the opposite breast and down to the iliac crest, may conceivably sever lymphatics which might aid in the restoration of the lymphatic circulation. The performer of plastic operations presumably asks himself whether skin enough to make possible the use of his favorite method can be preserved; whereas the advocate of skin grafting who understands its possibilities may sacrifice, without concern about the closure of the wound, as much skin as seems to him desirable. It is unfortunate that surgeons should permit themselves to be placed in the predicament of choosing either to incur greater danger of recurrence or to imperil the success of a plastic method.

During the past year we have been making a careful search for cases of swollen arm following operation at The Johns Hopkins Hospital for cancer of the breast and, although at this writing we are not prepared to submit figures, may state that the records support our view that infection is very frequently, if not indeed usually, the overlying cause of the swelling of arms whose main lymphatic channels have been more or less blocked by operation. The infection may quite conceivably be so mild in degree as to escape the observation even of those intently on the lookout for it.

If the view expressed in this paper as to the cause of the swelling of the arm following operations upon the axilla should prove to be correct the term *surgical elephantiasis* (*Elephantiasis chirurgica*) might be an appropriate one.

The most common cause of the late postoperative swelling is, of course, the recurrence of the disease, a recurrence which blocks new channels. But swelling in its most aggravated form is seen with the recurrences accompanied by inflammation—it may be only the reactive inflammation incident to the rapidly growing neoplasm. Now the question naturally presents itself as to whether the reactive inflammation in some of these recurrent cases may not be partly of bacterial origin—an inflammation superimposed upon the tissues engorged from lymphatic and frequently also from venous obstruction. It would seem to me to have been determined from clinical observation that lymphatic obstruction predisposes to streptococcal inflammation, but it remains for us to confirm this hypothesis by experimental demonstration on animals. We have been impressed with the fact that

lymphangiomata seem predisposed to infection, and to recurrent attacks of inflammation.

The clinical and experimental evidence bearing on the part played by streptococcal infection in the production of elephantiasis and elephantoid conditions has been admirably summed up by Matas:[6]

By elephantiasis we mean a progressive histo-pathologic state or condition which is characterized by a chronic inflammatory fibromatosis or hypertrophy of the hypodermal and dermal connective tissue which is preceded by and associated with lymphatic and venous stasis, and may be caused by any obstruction or mechanical interference with the return flow of the lymphatic and venous currents in the affected parts. In order to bring about the hypertrophy of the connective tissue, which is the distinctive feature of the true elephantiasic state, the mechanical impediment to the lymphatic and venous drainage of the part is not sufficient, because a simple mechanical obstacle, while causing a regional or localized dropsy or lymphoedema, will not bring about the characteristic fibromatosis and other histologic changes which are peculiar to elephantiasis. As Unna, Darier and many others have well shown, a simple mechanical oedema is incapable of exciting a proliferation of the collagenous connective tissue. We know by clinical observation that oedema may exist many years in the extremities and other parts without causing any fibromatosis or hyperplasia of the connective tissue of the parts. Something more than lymph stasis is required, and that something is infection with pathogenic organisms, and especially those of the streptococcal type which find a favorable soil for development in the stagnant lymph stream. The histopathological elements which are essential to complete the picture of elephantiasis are: (1) a mechanical obstruction or blockade of the veins and lymphatics of the region, usually an obliterative thrombo-phlebitis or lymphangitis or adenitis; (2) hyperplasia of the collagenous connective tissue of the hypoderm; (3) gradual disappearance of the elastic fibres of the skin; (4) the existence of a coagulable dropsy or hard lymph oedema; and, (5) a chronic reticular lymphangitis caused by secondary and repeated invasion of pathogenic microorganisms of the streptococcal type.

If we adopt this conception of the histologic process which underlies the pathology of elephantiasis as it is recognized in its endemic tropical types, as well as in the sporadic cases, which may occur in all climates, we can readily appreciate that the histologic process is of a generic character, though it may be initiated by many specific causes—the underlying histologic background remaining, however, always the same. In this manner, we can easily reconcile the many conflicting views relative to the pathology of elephantiasis. The long established duality of classification of the disease into the classic *Elephantiasis tropicum,* which is usually attributed to the presence of *Filaria nocturna,* or the strictly parasitic type of the disease, and the

[6] The Surgical Treatment of Elephantiasis and Elephantoid States Dependent Upon Chronic Obstruction of the Lymphatic and Venous Channels. With Case Reports by the Author and Hermann B. Gessner, M. D., School of Medicine, Tulane University of Louisiana, New Orleans. Amer. Jour. of Trop. Dis. and Prev. Med., 1913, i, 60-85.

Elephantiasis nostras streptogenes, which prevails in all climates, no longer suggests distinct and specific types of the disease. These are histologically alike as morbid processes, and only differ in the primary cause of the lymphatic and venous obstruction which initiates the process. Therefore, while nosologists classify elephantiasis into the previously mentioned groups, it is evident that the elephantiasic process is always one and the same; always maintaining similarity of histologic type regardless of the multitude of causes that may bring it into existence. The one etiologic factor which seems to be inseparable and essential to its pathogeny is infection—frequently repeated—which brings about permanent alterations in the vasculolymphatic apparatus of the skin and its underlying connective tissue. The reason why elephantiasis, as a clinical entity, is so much more frequent in the tropics than elsewhere, is because the conditions which predispose to and favor cutaneous infection as well as lymphatic obstruction, are so much more frequent there than in colder climates; greater exposure of skin areas, especially the lower extremities, to traumatisms of all sorts; greater activity and, consequently, greater irritability of the skin; universal presence of suctorial insects and gross parasites; and greater frequency of eruptive diseases, etc., all of which tend to open wide the portals of infection. It is now pretty well admitted that filariasis is only one of the causes that initiate the elephantiasic process even in the tropics. Certainly, the filariae are not so frequent a cause of the disease as was formerly believed. The incidence of filariasis is not coincident with that of elephantiasis. For instance, Creighton Wellman (Journal of Trop. Med., 1908, p. 118), while stationed as health officer at the Portuguese Colony of Angola, in West Africa, had many opportunities for investigating the relationship between filarial disease and elephantiasis and in a careful study of fifty cases he never found any evidence of embryo filariae in the blood, or, for that matter, in the blood of five hundred individuals in that colony, whom he examined for evidence of filarial disease. Le Dantec had a similar experience in French Guiana, where elephantiasis is common and filariasis very rare. Prout, in Sierra Leone (1908), observed a great many cases of filariasis in that colony, but met with a similar experience in the Congo, where filariasis is almost a universal disease. Sir Patrick Manson, who immortalized himself by his researches into the mode of propagation of filarial disease through the agency of the mosquito, and was the first to establish the relations of filariasis to elephantiasis, has modified his earlier views on the relationship of filiarial parasitism to elephantiasis. In his work on Tropical Diseases (1907) he now teaches that the mechanical obstruction of the lymphatics caused by *Filaria bancrofti* is not alone sufficient to cause elephantiasis, and that a secondary microbial infection of the obstructed area is necessary to cause the tissue changes of elephantiasis. This same observer writes:

"Lymphatic stasis, by itself, does not cause elephantiasis. The obstruction may cause lymph oedema, but not a true hypertrophy of the oedematous tissues. If an inflammation (infection) is acquired in a closed area of lymphatic congestion, an event which may result as a consequence of the slightest traumatism, elephantiasis will then develop."

According to Low, if a lymphatic obstruction caused by adult filariae is followed by an attack of erysipelas, the filarial embryos are killed and their

disorganization is a cause of the lymphangitis which culminates in elephantiasis. Clinical observation also abundantly shows that if a lymph scrotum develops as a consequence of filarial obstruction, it will remain a plain lymph scrotum for an indefinite period of time, and will only become an elephantiasic scrotum when repeated attacks of erysipelatous infection follow in the wake of the mechanical stasis and in this way starts the fibromatous process which is the histologic essential of elephantiasis. The burden of this discussion is merely to show that even in tropical climates where filariasis prevails endemically, elephantiasis is a diseased state not subject to one cause, but to many, and, in fact, to any agency that may obstruct the lymph stream provided dermal infection follows in the wake of lymph stasis. We have now come to realize that whatever the cause of the lymph oedema may be, the element of infection is the one essential and determining factor in the production of true elephantiasis. In fact, if we accept the views of many writers, such as Le Dantec, Sabouraud and Unna, the progressive fibromatosis which we recognize as *Elephantiasis nostras,* may occur independently of any stagnatory state of the lymphatic or venous circulation, and solely as a result of repeated attacks of a streptococcal infection, which has been regarded by many as identical with the erysipelas coccus of Fehleisen. Moreover, the streptococcal infection of elephantiasis presents all the characteristics of the classical cutaneous erysipelas, with the exception that in elephantiasis it is usually limited to one particular region in the lower extremity, the eruption rarely extending beyond the groin. It is rarely ambulatory or migratory as is the case with the well-defined type of erysipelas.

This association of a streptococcal infection of the erysipelatous type is, we repeat, almost an inseparable and constant feature of elephantiasis, no matter what the original predisposing cause may be. It is also this association of the erysipelatous attacks, with the progressive hyperplasia of the dermal and hypodermal connective tissue of the affected region, that distinguishes true elephantiasis from the elephantoid states. Sabouraud, who has given much attention to the bacteriology of elephantiasis, Unna, Le Dantec, Bockhart, and others, agree that the microorganism is a distinct *Streptococcus* which cannot be morphologically distinguished from the Fehleisen coccus of erysipelas. Le Dantec describes in addition a special coccus which he designates as the lymphococcus; Renon found the pneumococcus. But there is no question that from the clinical point of view, the recurrent streptococcal infection which is peculiar to elephantiasis is similar to that of erysipelas. In the many cases that have come under our observation, the history of repeated attacks of erysipelas has been invariably connected by the patient with the origin and evolution of the disease. Sir Joseph Fayrer applied the term elephantiasic fever to the febrile manifestations which accompany the appearance of the local erysipelatous rash. The fever is usually ushered in by chill or rigors, and the temperature rises to 103° or 105° F. and is followed by remissions and profuse sweats. The fever usually lasts from two to eight days and defervesces with the subsidence of the erysipelas, which rarely extends beyond the root of the limb. During the attack, the skin of the affected region becomes red, painful, swollen, and looks exactly like the erysipelas rash; the lymph nodes are enlarged and the redness diffuses itself with great rapidity over the entire surface of the limb. After

the subsidence of the attack, the skin remains swollen, giving the impression of a soft, doughy oedema. The soft consistency gives place to a more permanent hardness, the skin of the affected part never returning to normal. The underlying soft parts unite with the skin, which increases very much in thickness, forming a firm, immovable mass of tissue which continues to grow until it finally assumes a monstrous size (Elephant's foot, Barbadoes leg, etc.) which is characteristic of the disease.

The development of elephantiasis by inoculation of pure erysipelous cultures was experimentally tested by Bockhart, Sabouraud, Le Dantec and others. In accounting for the repeated or recurrent attacks of this streptococcal infection, Unna (Histopathology of the Skin, Walker's translation, p. 493) states:

"It is in the highest degree probable that the true sporadic cases of elephantiasis develop from incompletely healed erysipelas—that is, those which leave behind disturbances in the circulation. The streptococci remain latent in the tissues and in this way excite the chronic proliferative tissue changes which we subsequently recognize as elephantiasis. At first the attacks of erysipelas occur at long intervals, perhaps twice or three times a year, then once a month, rarely oftener. Each time the limb grows larger until in the course of time a distinct elephantiasic state is established. Natural immunity does not appear to be easily acquired; and once the erysipelatous habit, so-called, is acquired, it usually becomes a permanent feature of the disease, though in some cases the attacks become milder and disappear altogether, but not until the elephantiasic state is fully established."

THE ORIGINAL CONCEPTION OF THE COMPLETE OPERATION FOR CANCER OF THE BREAST[1]

You ask me to say something of my share in the development of the operation for cancer of the breast. This is pretty clearly stated in my first paper (Johns Hopkins Hospital Reports, 1890 and 1895). Volkmann had recommended stripping the fascia from the pectoralis major "as for a classroom dissection," and Heidenhain (Küster's assistant at Marburg) proposed cutting away the superficial fibres of this muscle. I advised and practised the removal of the entire muscle, leaving in most instances the upper or subclavicular bundles (those above the cephalic vein); I divided the pectoralis minor to further facilitate the cleaning of the axilla. A year or two later Willy Meyer advised removing the minor muscle as well as the major, and I, too, came independently to the conclusion that this might better be done. I insisted that all the tissues should be removed in one piece and upon the meticulous cleaning of the axilla and its aestuaries (subclavicular and supraclavicular fossae). I warned of the danger of excising pieces of malignant tumors for microscopic examination unless the operation followed immediately, and was, I think, one of the first surgeons in this country able macroscopically to make the diagnosis of the common tumors.

[1] A letter to Dr. William H. Welch of Baltimore, Maryland, dated August 26, 1922. Not previously published.

SURGERY OF THE THYROID, PARATHYROID, AND THYMUS GLANDS

AN EXPERIMENTAL STUDY OF THE THYROID GLAND OF DOGS, WITH ESPECIAL CONSIDERATION OF HYPERTROPHY OF THIS GLAND[1]

In 1887 Munk[2] made the remarkable statement that dogs survived experiments which deprived them of the function of the thyroid gland (Ausschalteversuche), provided that the wounds healed "well" by first intention; but if swelling of the wound supervened, swelling of an inflammatory or oedematous nature, swelling dependent upon haemorrhage or upon an accumulation of the secretions of the wound, then very soon appeared the symptoms characteristic of extirpation of the thyroid gland. These symptoms, developing possibly somewhat slower than after extirpation of the gland, became gradually more and more pronounced and finally the animal succumbed. In some cases, those in which the swelling subsided in a short time, the symptoms disappeared and the dog made a perfect recovery. If there was an accumulation of pus in the depths of the wound, or if there was suppuration enough to be perceptible, the dogs, without exception, died as promptly as if complete extirpation had been performed.

Munk performed his operation for complete isolation of the thyroid gland as follows: after doubly ligating and dividing the veins which leave the lower ends of the thyroid lobes and, when necessary, doubly ligating and dividing the vessels which go to and from the sides of the glands, he lifted them out of their so-called capsules and completely severed their active connection with the body of the animal by ligation of the vessels and nerves of the hilus. He then returned the lobes to their original position, and in order to keep them the more perfectly in place he tied together the ligatures which had been applied to their lower veins.

Nine dogs survived Munk's isolation experiments. He does not give the number of his experiments. At Munk's instigation, Boginsky repeated these experiments and reported identical results.

Particularly surprising was the statement that "whenever a considerable portion of the lobes became attached the symptoms of thyroid extirpation manifested themselves, and the dogs with few exceptions died; whereas the other dogs whose lobes had either entirely disappeared or had in exceedingly small parts become attached, remained free from all symptoms and continued to live in the enjoyment of good health."

[1] Johns Hopkins Hosp. Rep., Balt., 1896, i, 372-408. (Reprinted.)

[2] Hermann Munk: Untersuchungen über die Schilddrüse. Sitzungsberichte der königlich-preussischen Academie der Wissenschaften zu Berlin, 1887.

Whenever the wounds healed well by first intention the thyroid gland had in eight or ten days entirely or almost entirely disappeared. When there was a transitory swelling of the wound and when, nevertheless, the dogs recovered from the experiment, he found even after from two to five months that the thyroid lobes had become attached and were of considerable size. Munk reserved for a subsequent communication[3] his explanation of these results. He compelled one, nevertheless, to anticipate that he proposed to regard the thyroid gland as a superfluous organ and to attribute the fatal results which attend extirpation of the thyroid gland to injuries done to nerves. That the injury to the nerves should necessarily be less from the operation for isolation than from the operation for extirpation of the thyroid glands I could not conceive.

Of the several unsatisfactory interpretations of the results of Munk's experiments which suggested themselves to me was one which promised for these experiments an important practical bearing upon surgery, and induced me soon after the appearance of Munk's paper to repeat them. Although Munk believed his experiments to be a refutation of Schiff's transplantation experiments I thought that I saw in them a possible confirmation of Schiff's work.

Munk could not find in dogs the accessory thyroid glands which are probably invariably and certainly almost invariably present, and might, I thought, have failed to see the attached remains of an isolated thyroid lobe, or to observe that a little active thyroid tissue remained in the otherwise necrotic gland. His isolation experiments were practically transplantation experiments; and I was encouraged from my interpretation of his results to believe that it might be possible to transplant a thyroid lobe from one dog to another, and a part of the thyroid gland from man to man.

To repeat Munk's work was to make three experiments in one. For whatever might be the effects produced by isolation of the thyroid lobes the experiments would at least be equivalent to transplantation experiments under most favorable conditions, and should the glands become necrotic and fail to be reinstated as glandular organs the isolation experiments would be equivalent also to extirpation experiments.

Examples of Complete Isolation of both Thyroid Lobes

Example 1.—*Isolation of both Thyroid Lobes by Ligation. Munk's Operation.* Dog 23. February 28, 1888.

The wound was closed with buried skin sutures of silk and dressed with horse-hair. The dressing was held in place by a plaster of Paris bandage.

[3] Sitzungsberichte der königlich-preussischen Academie der Wissenschaften zu Berlin, 1888. Munk speaks here of lesions of the laryngeal and vago-sympathetic nerves.

March 2d.—The dog has trismus. Tonic spasms of his legs developed while his temperature was being taken. These spasms subsided completely before the thermometer was removed. Tem. 39°. Resp. 33.

March 3d.—The dog has conjunctivitis of both eyes. It is more pronounced in the left than in the right eye.

March 4th.—The right eye is clear. The conjunctivitis in the left eye is worse. Temp. 39°. Resp. 19. There is a persistent erection of the penis. There are fibrillary tremors of the tongue and of the muscles in general. Temp. 38.5°. Resp. 18 and labored.

March 9th.—The dog drinks milk freely, but is very weak. His tremors are less marked.

March 12th.—The dog is found dead.

Autopsy.—The wound is beautifully healed, the cicatrix scarcely visible. The thyroid lobes are firmly adherent to the surrounding tissues. There is a greyish yellow semi-fluid zone beneath the capsules of the thyroid lobes. The left lobe is completely surrounded by this zone, which is about 2 mm. thick. The right lobe is surrounded only at its lower end by this zone. The upper two-thirds of the right lobe is of a mottled color. All the organs appear to be healthy.

Microscopical Examination of the Fluid Subscapular Zone.—The fluid contains no pus, but is rich in large cells which are filled with fat molecules. These cells have about the size of large leucocytes.

Microscopical Examination of the Upper Part of the Right Thyroid Lobe.—There is an exquisite fatty degeneration of the periphery of the lobe. This zone of degeneration is about 3 mm. deep. In the central portion of the lobe the gland structure can be made out. The follicles seem to be lined and sometimes partly filled with epithelium. The epithelial cells contain no fat, and the nuclei either do not stain at all or stain very feebly with Bismark brown. The cells have a homogeneous, glistening appearance. There are many colorless acicular crystals (fat crystals) among the epithelial cells. Yellow amorphous and crystalline haematodin is scattered through the central portion of the lobe and also in the peripheral fatty zone. In the peripheral zone the outlines of the follicles are almost lost. Leucocytes have wandered in from the capsule of the lobe along the connective tissue septa between the follicles.

EXAMPLE 2.—*Isolation of both Thyroid Lobes by Ligation.* Dog 24. February 28, 1888.

The wound was closed with buried sutures and dressed with horse-hair. The dressing was held in place by a plaster of Paris bandage.

March 1st.—The dog takes milk eagerly and without immediate bad effects.

March 4th.—Soft yellow stools. Temperature 39°.

March 5th.—The dog has fibrillary tongue spasms.

March 8th.—The fibrillary spasms continue.

March 9th.—The dog has no tongue spasms.

March 13th.—There are fibrillary contractions at the tip of the dog's tongue, but no other spasms. The dog drinks milk freely.

March 14th.—The dog is found dead.

Autopsy.—The wound is beautifully healed. The tip and edges of the tongue have sloughed away. Both thyroid lobes are firm and very large and adherent to the surrounding tissues.

Microscopical Examination of Frozen Sections.—Organization of the glands is going on from the periphery towards the centre. The leucocytes have wandered in along the septa of the glands, and new tissue is forming in place of the old which is necrotic.

The thyroid lobes of twenty-four dogs were isolated in the way which Munk describes. The wounds of twelve of these healed absolutely per primam.[4] All of the dogs died in from two to nineteen days, and with the symptoms which are characteristic of extirpation of both lobes. The isolated lobes of the dogs whose wounds healed per primam were without exception necrosed. Absorption of the lobes began almost immediately, and in some instances had progressed so far that no trace of them remained except a yellowish stain of the tissue in which they had been imbedded (*vid.* Table II). One dog (No. 59) remained perfectly well for sixty days after the isolation of both lobes and until killed by other dogs. His neck was so mangled by the teeth of the dogs that it was impossible to find the accessory thyroid glands or any trace of the isolated lobes. I regard this as one of the very few but undoubted instances of survival of dogs after extirpation of both thyroid lobes. We consider it a very great misfortune that this dog, which interested us perhaps more than all of the others, should have been killed, and furthermore, so mangled that we could learn nothing from the autopsy. The constant or almost constant presence of accessory thyroids explains the fact that dogs occasionally survive the extirpation of both lobes. Our piecemeal extirpation experiments have proved that some dogs may live with the one-eighteenth part or less of both lobes. But we have occasionally found the sum of the accessory thyroids to be apparently greater than this and still insufficient for the life of the dog.

The quality of the gland and the individual requirements of the animal are factors about which we know little, and which may be more important than the actual quantity of thyroid tissue.

[4] The wounds of eight dogs suppurated. Two dogs died on the second day or too early to permit one to say positively that the wounds had healed per primam; and in two instances the wounds were found distended with blood at the autopsy. If it had occurred to me at the outset to use the buried skin sutures I believe that fewer cases would have suppurated; for of the five cases which antedated the use of buried skin sutures, four suppurated, and of the nineteen cases in which these sutures were used only four suppurated.

We have made sixty-three total extirpations of the thyroid lobes.[5] All of the dogs except the one referred to (No. 59) died in from two days to three weeks, and almost invariably with the typical symptoms (*vid.* Table III). Of eighty-eight transplantations[6] of the thyroid lobe into the neck not one was successful. In fifty-three of these the wound healed per primam. In two or three instances small vessels had invaded the periphery of the necrotic gland and had converted a thin zone of the cortex into connective tissue. In the genuine transplantation experiments the transplanted lobes were absorbed just as promptly as the isolated lobes in Munk's experiments (*vid.* Tables II and IV).

PARTIAL ISOLATION OF BOTH THYROID LOBES. THE LARGE BRANCH OF THE THYROID ARTERY WHICH GOES TO THE UPPER POLE AND THE VEIN FROM THE LOWER POLE ARE NOT LIGATED; OTHERWISE BOTH THYROID LOBES ARE COMPLETELY ISOLATED.

EXAMPLE 1.—Dog 104. April 19, 1889. Open wound.

April 28th.—The dog seems perfectly well. The wound is healed.

April 30th.—The dog has tongue tremors and makes the licking movements with the tongue which we have frequently observed in dogs whose thyroids have been extirpated.

May 1st.—The tongue tremors are less pronounced. The licking movements are still vigorous.

May 7th.—The tongue tremors are pronounced. The dog has no general spasms.

May 14th.—The tongue tremors are very faint.

May 28th.—Dog seems perfectly well.

June 24th.—Hair is falling out, particularly over the eyes.

June 25th.—The dog has escaped.

June 27th.—Returned of his own accord. The hair is very thin all over his body. He scratches himself constantly. The oedema caused by the scratching gives to the skin about the face and head somewhat the appearance of myxoedema.

July 10th.—Has lost most of his hair. He is very anaemic. His blood is used for direct transfusion into dog 109.

Autopsy.—Both thyroid lobes are large and hard and very firmly bound down to the surrounding tissues by adhesions. With the microscope they were found to be hypertrophied. I believe, judging from the next example (dog 103), that this dog would have died ultimately with the symptoms of thyroid extirpation.

[5] Thirty-seven of these are recorded as such. Twenty-six piecemeal experiments are not so recorded, for they are of interest chiefly in this, that they were made to determine approximately the time of the first indications of hypertrophy in one lobe after excision of the other.

[6] Munk's isolation experiments, as already explained, are equivalent to transplantations, and have been counted as such.

Example 2.—Dog 103. April 19, 1889. The wound is left open. The dog was profoundly depresed after the operation.

April 27th.—There is conjunctivitis of both eyes. The wound is doing well.

April 28th.—The dog has symptoms which are characteristic of extirpation of both thyroid lobes. He shivers, has tongue tremors and general tonico-clonic spasms. His gums are inflamed. The membranae nictitantes are conspicuous. He groans with each expiration.

April 30th.—The tongue tremors persist. The general spasms have ceased. The conjunctivitis is more pronounced. There is a very offensive gingivitis. Dog makes peculiar, almost incessant licking movements with his tongue. These peculiar licking movements have been frequently observed by me in dogs whose thyroid glands have been extirpated.

May 1st.—Seems better. He still has tongue tremors.

May 3d.—His hind legs are slightly stiff. The tongue tremors are scarcely perceptible.

May 7th.—The tongue tremors are a little more distinct. The conjunctivitis has almost subsided.

May 14th.—The tongue tremors are very faint. There is no conjunctivitis.

May 19th.—All the symptoms of extirpation of both thyroid lobes have reappeared.

May 21st.—The dog seems much better. The tongue tremors are very faint. There are no other symptoms. There is a slight subconjunctival injection.

May 23d.—Except for the faint tongue tremors the dog seems fairly well. He eats well, but is very thin.

May 24th.—Has no tongue tremors, but strong clonic spasms of the flexor muscles of all of his legs. The spasms of the temporal and ear muscles are especially pronounced.

May 25th.—Dog has no spasms and is much better.

June 14th.—All the symptoms of double extirpation have reappeared.

June 15th, a. m.—Is found dead.

Autopsy.—The left thyroid weighs 3 grms. and is very hard. The right thyroid weighs 1 grm. For the microscopic appearance of both lobes see Plate LXXVII, 3. The fatal result in this and the preceding case (104) is to be attributed probably to extensive destruction of the glands by blood extravasation. Otherwise we could not regard the changes which we designate as hypertrophy as very highly compensatory; for, notwithstanding the fact that the glands weighed two or three times as much as normal and showed the most advanced stage of hypertrophy, one dog died with symptoms of total extirpation and the other had the symptoms which I have described (dog 104), and would probably have died of thyroid privation.

Piecemeal Extirpation of the Thyroid Gland

Example 1.—Dog 81. *Operation 1, October 4, 1888.—Removed the lower half of the left thyroid lobe.* The piece removed weighs 0.45 grm. and is normal. The wound was left open and without a dressing.

October 13th.—The dog seems quite well. His gums are abnormally pale. There are no symptoms of thyroid extirpation.

November 22d.—Has been quite well since the operation.

Operation 2, November 23d.—Fifty days after the first operation. *Removed the upper, the remaining half of the left thyroid and the lower third of the right thyroid lobe.* The wound was left open and without a dressing. The upper half of the left thyroid weighs 0.70 grm. The right gland is large and would weigh about 2 grms.

November 24th.—Seems perfectly well.

December 5th.—The dog has apparently been well ever since the last operation. The membranae nictitantes seem to be abnormally conspicuous.

January 10, 1889.—Three or four days ago began to cough. He is less lively than heretofore, and has a slight conjunctivitis. He eats well.

February 1st.—Acts as if he were partially blind and abnormally stupid. He does not see meat which is thrown to him; he finds it by the sense of smell. Dr. Randolph has today examined the dog's eyes ophthalmoscopically and pronounces them normal.

April 30th.—Is stupid and partially blind; otherwise apparently well.

Operation 3, April 30th.—Removed the lower half of what remained of the right thyroid—its middle third. The piece removed weighs 1 grm.

August 9th.—The dog is well, but is slow to see and catch his food.

Operation 4, August 9th.—Removed the second sixth of the right thyroid gland—the lower half of the remaining third. There remains to the dog one-sixth of one thyroid lobe.

August 24th.—Has been well since the last operation. This a. m. he was strangled to death by the impaction of a large piece of meat in his oesophagus.

Autopsy.—The dog is very well nourished. The wound is healed. There are two accessory thyroids under the arch of the aorta, and one at the lower border of the hyoid bone on the thyrohyoid membrane. All the organs are apparently healthy. The aortic thyroids show a more advanced stage of hypertrophy than does the gland which was found on the thyrohyoid membrane. Usually the accessory thyroids and the remainder of the thyroid lobes are hypertrophied to a like degree.

Piecemeal Extirpation of the Thyroid Gland

Example 2.—Dog 86. *Operation 1, October 23, 1888.—Excised the lower half of the left thyroid lobe.* The wound is left open and without a dressing. The piece weighs 0.6 grm. Its structure is normal.

December 12th.—Dog has been perfectly well since the first operation.

Operation 2, December 12th.—Excised the upper half of the left and the lower half of the right thyroid lobe. The wound was left open and without a dressing. The upper half of the left thyroid lobe weighs 2 grms., and the lower half of the right 1 grm. The left lobe was slightly adherent to the surrounding parts. For the structure of the pieces removed see Plate LXXVII, 1 and 4.

February 12, 1889.—Dog has been perfectly well since the last operation.

Operation 3, February 12th.—Excised one-half of the remaining upper half of the right lobe (its second fourth). The wound is left open. The excised piece is typically hypertrophied (*vid.* Plate LXXVII, 5).

April 27th.—Dog has been perfectly well since the last operation.

Operation 4, April 28th.—Excised the lower half of the remaining upper fourth of the right lobe—the second eighth of the right thyroid (*vid.* Plate LXXVII, 2 and 3).

There now remains to the dog one-eighth of one thyroid lobe, or one-sixteenth of the gland.

May 19th, a. m.—Is found dead. Has had all the symptoms of double thyroid extirpation for about two weeks, and has refused food since May 2d.

Autopsy.—The wound is healthy and nearly healed. Over the thyrohyoid ligament in the median line, and partially concealed behind the hyoid bone, is an accessory thyroid about the size of a very small bean. The remaining eighth of the right lobe weighs about 0.8 grm.

There is a small bean-like accessory thyroid gland under the skin about one inch above the sternum; also a chain of four enlarged aortic thyroids. The accessory thyroids have the structure which we call hypertrophy. The hypophysis cerebri has the size of a large French pea. All the organs appear to be healthy.

Piecemeal Extirpation of the Thyroid Gland

Example 3.—Dog 90. *Operation 1, October, 1888.—Excised the lower half of the left thyroid lobe.* The wound is left open and without a dressing. The piece removed weighs 0.3 grm. Its structure is normal.

November 20th.—The dog has been fairly well since the operation, but his hair is falling out. He is entirely bald about the right eye.

December 30th.—Has a cough and been quite sick for three or four weeks. Has probably had pneumonia and is now convalescing.

January 29th, 1889.—The dog has been well since January 1st.

Operation 2.—Removed the upper half of the left and the lower two-fifths of the right thyroid lobe.

Both lobes seem to be hypertrophied, and both are adherent to the surrounding tissues. The left one is very firmly bound down by adhesions. For the stage of hypertrophy of the pieces removed, see Plates LXXI and LXXVII, 4.

April 30th.—The dog has been perfectly well since the last operation. He is sire to the pups with the enormously hypertrophied thyroids thrown by bitch 97 on the 13th of April.

Operation 3, April 30th.—Removed the lower half of the remaining three-fifths of the right thyroid lobe. The piece removed weighs 1.5 grm. For the minute structure, see Plates LXXI and LXXVII, 4.

June 20th.—Since the last operation the dog has been growing sluggish and stupid. When released from his cage he takes a few steps and then lies down. He has had no convulsions nor tremors.

June 21st.—Died this morning.

Autopsy.—The remaining portion, the upper three-tenths of the right thyroid lobe, weighs 2 grms. For the structure, see Plates LXXI and LXXVII, 1 and 4. It is very firm and has a nearly globular shape. Accessory thyroid glands were not found at the autopsy which, however, was made in my absence. There is general pulmonary oedema. The other organs appear to be healthy. The dog was not emaciated. There is no apparent oedema of the subcutaneous tissues.

Piecemeal Extirpation of both Thyroid Glands

Example 4.—Dog 97. *Operation 1, November 14, 1888.—Removed the upper third of the left lobe.*

The piece removed has a normal structure. The wound was left open.

December 12th.—The dog (bitch) has been perfectly well since the operation.

Operation 2.—The neck was opened through the cicatrix for the purpose of removing what remained of the left thyroid.

The ligature which had been applied at the first operation was found imbedded in a little new tissue. Not a trace remained of the left thyroid.

April 11, 1889.—The bitch is at full term. Has convulsions and behaves precisely as do the dogs whose thyroids have been completely extirpated.

April 12th.—Had today three or four convulsive seizures. Each attack lasted about one hour. Otherwise the bitch seems well and in good spirits.

April 13th.—Bitch has whelped five pups. Two alive and three dead. Dog 90 is sire of the pups. He impregnated this bitch when he had been deprived of all of one lobe and two-fifths of the other, and when she possessed only one lobe. The pups which were born alive died this evening. The thyroid glands of these pups are many times (at least 20 times) larger than normal. See Plate LXXVII, 5, *c*. Compare with normal thyroid of newborn pup, Plate LXXVII, 5, *a*, and photographs (Plates LXVII to LXXV).

Operation 3, April 30th.—Removed the lower half of the right thyroid gland. The gland is very large and decidedly spindle-shaped. It is hypertrophied. See Plate LXXVII, 3.

November 11th.—Has been well since the last operation.

Operation 4, November 11th.—Removed what I believed to be the second fourth—the lower half of the remaining half—of the right thyroid lobe.

January 1, 1890.—The piece removed November 11th was today examined and supposed to be lymphatic gland tissue. Unfortunately the specimen of this piece has been lost.

I now suspect that it was thyroid gland and not lymphatic[1] tissue.

Operation 5, January 6th.—Explored the right side of the dog's neck very carefully. Could find nothing but a small nodule, at the lower end of which was what seemed to be a ligature of the previous operation. Removed this nodule. It proved to be hypertrophied thyroid tissue. *Vid.* Plate LXXVII, 3.

January 13th.—The dog has tongue tremors and general spasms and behaves as do the dogs whose thyroids have been extirpated.

January 14th.—Is dead.

Autopsy.—Nothing remains of either thyroid lobe. An unusual number of hypertrophied accessory thyroids are found; viz., one in front of the arch of the aorta; three behind the arch near the origin of the ductus Botali; one large gland, 3 mm. × 4 mm., behind the sternum. For the minute structure of these hypertrophied glands, *vid.* Plate LXXVII, 3. This figure is intended to represent the most advanced stage of hypertrophy; but it is very badly executed.

[1] We have twice labeled as *lymphatic tissue* specimens which we subsequently found to be thyroid tissue in the extreme stage of hypertrophy.

Piecemeal Extirpation of the Thyroid Gland

Example 5.—Dog 126. *Operation 1, December, 1888.—The lower end of the left thyroid gland was ligated at about 2 mm. above its tip.* The wound is left open.

April 22, 1889.—The dog has been perfectly well since the operation.

Operation 2.—One hundred and thirty-two days after the first operation. *Removed the remainder of the left and the lower two-fifths of the right thyroid gland.* Both glands were hypertrophied. *Vid.* Plate LXXVII, 2 and 3, and photograph. There were no adhesions binding the thyroids to the surrounding tissues. The tied-off tip of the left lobe is converted into connective tissue. Here and there traces of follicles remain in this tip.[8]

August 9th.—Dog has been perfectly well since the last operation.

Operation 3.—Removed the lower half of the remaining three-fifths of the right thyroid gland.

For the minute structure, *vid.* Plate LXXVII, 2 and 3.

November 11th.—Dog has been very weak since the third operation and was scarcely able to walk when he was put on the table to be anaesthetized.

Autopsy.—What remains of the right thyroid gland weighs 0.75 grm. and is hypertrophied. Four accessory thyroids were found, two below and one behind the arch of the aorta, and one behind the hyoid bone at the upper end of the thyrohyoid membrane. The accessory thyroids were all hypertrophied, although very small. Not one of them was larger than a grape-seed. The dog has no myxoedema. For the minute structure of the hypertrophied accessory thyroids, *vid.* Plates LXXI and LXXVII, 1 and 4.

Piecemeal Extirpation of the Thyroid Gland

Example 6.—Dog 127. *Operation 1, December 11, 1888.—Ligated the lower end of the left thyroid gland at about 3 mm. from its tip.* The piece ligated was not cut off. The wound is left open.

April 22, 1889.—The dog has been perfectly well since the operation.

Operation 2.—Removed the remainder of the left thyroid and the lower third of the right thyroid gland. The wound was left open. The pieces removed were, much to my surprise,[9] normal 132 days after ligation of the inferior tip of the left lobe.

August 30th.—About nine weeks ago the bitch was impregnated by a good-sized, healthy, unoperated dog.

[8] In dog 127 the tied-off tip retained its original structure, and the operation (ligation of tip) was not followed by hypertrophy. See Example 6.

[9] I say *much to my surprise,* because in the preceding case (dog 126) the same operation was followed by hypertrophy in the same number (132) of days. But longitudinal sections of the entire lobes revealed the cause of the hypertrophy in the one case and the reason for its absence in the other. In both cases fragments of the ligature were found imbedded in a narrow connective tissue zone two or three millimetres above the inferior pole; but in 127 the gland tissue below the ligature was intact or very slightly modified by a little increase in connective tissue, whereas in 126 only an occasional trace of the gland remained.

She is about at full term and has today developed the symptoms characteristic of extirpation of both thyroid glands. She has tongue tremors and general clonico-tonic spasms.

September 1st.—Last night she gave birth to eight dead pups and seems perfectly well this morning. The thyroids of these pups are at least twelve times as large as normal.

November 11th.—The dog has been well since the last note.

This is the second opportunity that we have had to observe the effect of pregnancy upon a bitch deprived in part of the thyroid gland. In both cases for a few hours, less than twenty-four, just prior to whelping the symptoms of complete thyroid privation manifested themselves although each animal still possessed much more than enough thyroid gland for her ordinary wants.

It is interesting to note that pregnancy has already been supposed to have an influence in producing tetany, and that in at least two or three instances [10] it has been suspected that the tetany was caused by the complete or partial absence of the thyroid gland.

Operation 3.—Removed the lower half of the remaining two-thirds of the right thyroid gland. The gland is large, hard and very vascular, and shows, microscopically, an early stage of hypertrophy.

January 14, 1890.—The dog has been perfectly well since the last operation and has grown very fat.

Operation 4.—Removed the lower two-thirds of the remaining upper third—the second and third ninths—of the right thyroid gland.

The piece removed weighs 1.5 grms. It shows, microscopically, an advanced stage of hypertrophy. The gland was very adherent to the tissues surrounding it.

The dog is now reduced to one-eighteenth of both thyroids. The piece remaining—the upper ninth of the right thyroid—would probably weigh as much as the entire right thyroid originally weighed. The dog has been getting steadily fatter since the first operation, and now is enormously fat and well. There are no evidences of myxoedema. The dog seems mentally as active as ever.

Operation 5, January, 1891.—Removed the superior ninth, the remainder of the right thyroid gland.

The dog died within three days of the last operation.

Autopsy.—A chain of accessory thyroids was found behind the arch of the aorta, and one accessory thyroid on the thyrohyoid membrane, behind the hyoid bone.

These glands were not as large as I have several times found them. They were preserved, but cannot be found. What I have said about them is from memory.

The piecemeal resection experiments demonstrated conclusively that the symptoms which manifest themselves after extirpation of both thyroid

[10] Thomas, H. M.: Tetany in Pregnancy, Johns Hopkins Hospital Bulletin, May 20, 1895.

lobes are due to the loss of thyroid tissue, and not to the injury to the nerves of the neck, as Munk and others have supposed.

What part of both lobes a dog requires we have not tried to determine. It is probably never precisely the same for two dogs, and may depend somewhat upon the time allowed to intervene between the operations. Very few dogs can live with the accessory thyroids alone.

Dog 81 survived the excision in four operations of eleven-twelfths of the two thyroid lobes. He was in good condition when he died of strangulation from swallowing too large a piece of meat. Three small accessory thyroids were found at the autopsy.

Dog 86 enjoyed good health with one-eighth of the two lobes; but he died twenty-one days after the fourth operation, at which he was reduced to one-sixteenth of the two lobes. The fourth operation was performed six months after the first operation. For two weeks before his death he had the symptoms characteristic of total excision. At the autopsy five accessory glands were found, and the remaining piece of the hypertrophied right lobe weighed nearly one grm.

Dog 90 was reduced to about one-tenth of both lobes in six months by three operations. He died three weeks after the third operation, without active symptoms. The superior fifth or perhaps three-tenths of the right thyroid which was excised at the autopsy weighed one and one-fifth grammes.

Dog 97 when deprived of only one lobe developed the typical total extirpation symptoms a few hours before her pups were born. Nevertheless she recovered completely from the two subsequent operations and did not die until the final fragment of the right lobe was removed at the fifth operation. She died one week after the last operation—fourteen months after the first operation, and when nothing remained to her of the two thyroid lobes. An unusual number of accessory thyroids were found at the autopsy. What proportional part of both lobes the final piece represented I cannot say.

Dog 126 lived only three months with about one-tenth of the two lobes and with at least four accessory thyroid glands. The four operations were performed in eleven months.

Dog 127 enjoyed good health with one-eighteenth of the two lobes. This eighteenth weighed almost as much as the two lobes normally weigh. He died after the fifth operation, two years after the first operation, and not until the final piece had been excised. The accessory thyroids were not as large as we had expected them to be, nor as large as we have several times found them.

One of the most interesting discoveries to which our experiments led was the hypertrophy of the thyroid glands of the new-born pups of dogs whose thyroid lobes had been in part excised. The glands of all five of the pups

of bitch 97 were about twenty times as large as normal. *Vid.* Plates LXXV and LXXVII, 5, *a* and *c*. In all of the pups the two lobes seemed to be connected by a deep isthmus. *Vid.* Plates LXXV and LXXVII, 5, *c*. The lobes and isthmus together made a horse-shoe-shaped gland which embraced and almost surrounded the trachea. Our efforts to confirm this discovery were rewarded in less than a year by a litter of eight dead-born pups from bitch 127. (See full history.) The thyroid lobes of these pups were connected by a very short, thin isthmus, and were at least twelve times as large as normal.

Later a third litter of five pups, presumably at first from unoperated parents, was discovered in the kennels of the laboratory by the janitor, John Schutz, to whom I am greatly indebted for most intelligent assistance in my experimental work. The thyroid lobes of these pups were, much to my surprise, almost as large as the thyroid lobes of the pups of bitch 127, and for a short time our theory seemed to be insecure. Upon investigation, however, we found that the mother of the pups had been twice operated upon. The first operation was a laparotomy for the introduction of a syringeful of a bouillon culture of *Staph. aureus* into the abdominal cavity. A few months later the left thyroid lobe of this bitch had been excised, and found on microscopical examination to be hypertrophied. Impregnation occurred after the excision of the left lobe of the thyroid gland. The bitch was killed soon after the pups were whelped, and the above facts verified by the autopsy. The right lobe showed an advanced stage of hypertrophy.

We were, accordingly, so fortunate as to have three litters of puppies from bitches deprived in part of the thyroid gland. Bitch 97 was impregnated by dog 90, after his left and two-fifths of his right lobe had been excised. The other two bitches were impregnated by normal dogs. The thyroid glands of the puppies of bitch 97 were much larger than the glands of the puppies of the other litters. The former were, as I have said, about twenty times as large as our largest normal gland of a puppy at birth, whereas the latter were only twelve and ten times as large as they normally should be. In the minute structure, too, the former differed somewhat from the latter; for there was absolutely no colloid, and rarely a trace of a vesicle in the very large glands of the former, while in the latter there were still a very few vesicles and still occasionally a trace of colloid. The normal gland of a puppy at birth has many acini filled with colloid, but they are much smaller and much less preponderant than in the adult gland. The epithelium is much higher and the colloid much thinner in the puppy's than in the adult gland.

The structure of these greatly hypertrophied glands of puppies resembles closely that of the glandula parathyroidea.

It occurred to us, naturally, to inquire whether hypertrophy of the thyroid lobes might not occasionally exist in dogs whose neck had not been molested. I excised, accordingly, the left lobes of five dogs into whose abdominal cavities some months previously syringefuls of a bouillon culture of *Staph. aureus* had been introduced. The thyroid lobes of four of these dogs were hypertrophied.

The lobes of a dog which had fallen from the third-story window of the laboratory were hypertrophied.

Those of a dog which had just recovered from pneumonia were hypertrophied and most of the follicles were filled with cells, whereas those of a dog which had died of pneumonia were normal.

The thyroid glands of two dogs which had been confined for a long time in the laboratory were not hypertrophied.

Dog 136 was inoculated, February 4, 1890, with *Diplococcus pneumoniae*. Fourteen days later the left thyroid lobe was normal.

Dog 151, March 3, 1890. Excised the greater part of the left humerus for blood-clot experiment. Dead space allowed to fill with blood. March 24th, three weeks later, anaesthetized to death. Advanced hypertrophy of thyroid gland.

The janitor, John Schutz, who, as I have said, took a most intelligent interest in these experiments, examined for us the thyroid lobes of one hundred dogs in the city pound. Certainly one and probably two of these dogs had hypertrophied glands.

The left lobes of the dogs used for complete or piecemeal extirpation experiments were without exception, on microscopical examination, found to be normal.

The value of the closed wound experiments may well be questioned, for it will be observed that most of the dogs with closed wounds and plaster of Paris dressing died sooner or later, irrespective of the experiment. The one-sided transplantations and isolations, for example, resulted eventually in the death of the animal. These experiments should not ordinarily have been fatal. In some instances pneumonia, perhaps due to distemper, was the immediate cause of death. But in most cases the dogs died with a peculiar scurvy-like cachexia, to which most of the dogs with closed wounds and plaster of Paris dressing during the year 1888 succumbed.

Hence we cannot consider the question as to the possibility of transplanting the thyroid lobe into the neck of another dog as positively settled. We cannot account satisfactorily for the peculiar scurvy-like cachaexia which so many of the dogs with closed wounds developed. I am inclined to suspect that it may have been due in some way to the confinement caused by the dressing. The wounds were covered with a large pad of horse hair, and this

was held in place by a plaster of Paris bandage which immobilized to a certain extent the neck and the forelegs of the dogs.

Not one of the many dogs with open wounds developed this peculiar condition, nor did one of them die until enough, and usually more than enough, of his thyroid lobes had been excised to account satisfactorily for his death.

On September 20, 1888, Dr. Welch kindly presented at the meeting of the Association of American Physicians in Washington, an abstract of my experimental work on the thyroid glands of dogs and described the hypertrophy of these glands, upon which especial emphasis was laid. He demonstrated microscopical sections of the glands, and reported regarding the histological changes characterizing the hypertrophy and the conditions under which hypertrophy was observed. Dr. Welch's remarks on this subject were published at the time,[11] but they have escaped the notice of subsequent writers. Our published observations concerning hypertrophy of the thyroid gland, which will now be described in detail, date from the year 1888.

Before the first publication of my results in 1888 there was little evidence that after extirpation of a part of the thyroid gland the remainder hypertrophied.

Horsley[12] and Wagner[13] were the only ones who thought that they had observed hypertrophy of one lobe after excision of the other. Wagner's testimony was supported merely by his belief that in two instances the remaining lobe was larger than the one first extirpated; but Horsley had with the microscope observed changes which were described as follows: "The acini were found to undergo very remarkable changes. The epithelial cells lining them multiplied in number and increased in size, so that there was a plication of the acinal wall. The full reason for this folding was not clear. There was no increase in the number of the parenchymatous cells of Weber, and no metamorphosis of the embryonic tissue into acini. The colloid material did not increase in amount, but changed in consistence, became softer, more viscous and less solid, so that at one time it appeared like a network of viscosity, and later on had a watery aspect. Increased activity of the organ appeared therefore to cause a diminution in the consistence, and this was contrasted with the greater solidification of the acinal contents that occurred when the function was less active." "If the animal wasted after the removal of the lobe of the thyroid gland, then there need be, and probably would be, no hypertrophy of the remaining lobe." Horsley gives Lorenz credit for insisting on the importance of this matter of weight in

[11] The New York Medical Record, 1888. The Medical News (Philadelphia), 1888.

[12] Horsley: The Pathology of the Thyroid Gland, Lancet, Dec. 18, 1886.

[13] Wagner: Ueber die Folgen der Exstirpation der Schilddrüse nach Versuchen an Thieren. Wien. med. Blätter, 1884, Nos. 25 and 30.

determining hypertrophy, and has himself observed that if one kidney is excised and the animal loses in weight, the other kidney does not hypertrophy. I am not sure that this statement should not be reversed. I believe rather that the loss of weight was due to the fact that the remainder of the gland did not become hypertrophied, than that the absence of hypertrophy was caused by the loss of weight.

Fuhr [14] affirmed unreservedly that the observation of Wagner as to the hypertrophy of the remaining portion of the gland was disproved by his experiments and by those of Sanguirico and Canalis.[15]

To determine this point, Fuhr made six experiments. Eight, 25, 27, 28, 33, and 41 days intervened between the first operation when one lobe or parts of both lobes were removed, and the second operation when the remainder of the gland was excised. A glance at my table of hypertrophies (Table IV) will perhaps explain how it could happen that Fuhr did not in these experiments obtain hypertrophy of the thyroid gland.

With two exceptions I did not encounter advanced hypertrophy until after the 43d day. Fuhr might nevertheless have had hypertrophy in every case except the one in which only eight days intervened between the two operations, and we might have expected it in the 41-day case. The fact that hypertrophy did not occur in this last case was probably due to the nature of the experiment; for all of the arteries and veins at the hilus of both lobes were ligated and the upper poles of both lobes exsected.

Mr. Horsley was in America in 1889 and it gave me pleasure to show him my specimens. In 1891, in his famous article on the function of the thyroid gland,[16] he very courteously declines to say anything about the microscopic changes in the hypertrophied thyroid gland, and refers for this to my work [17] which was to have been published four or five years ago.

Notwithstanding the fact that Dr. Welch, in his abstract of my work on hypertrophy, described more than seven years ago the principal changes in the structure of the gland, subsequent writers and investigators do not seem

[14] Fuhr: Archiv für experimentelle Pathologie, No. 21, 1886, p. 449.

[15] Sanguirico and Canalis: Première communication préliminaire. Archives Italiennes de Biologie, T. V, 1884, p. 390. These investigators extirpated one entire lobe and the superior two-thirds of the other lobe of two animals. Both animals died, one on the third day, the other on the sixth day. The remaining pieces, as we should expect, showed no change; the time was too short for the development of hypertrophy. In two instances they extirpated one lobe and the inferior two-thirds of the other lobe. Both animals lived. The remaining piece was not examined in either case.

[16] Horsley: Die Function der Schilddrüse; eine historisch-kritische Studie. Internationale Beiträge zur wissenschaftlichen Medicin (Festschrift, Rudolph Virchow, gewidmet), Bd. i, p. 369.

[17] Horsley: *loc. cit.*, p. 387.

to suspect that a structural change is to be looked for in hypertrophy of the thyroid gland. Nor has any one observed the hypertrophy which almost invariably takes place in the remaining thyroid lobe within perhaps 40 days of the time of the removal of the other lobe. The isolated observations of Wagner and Horsley are referred to with scepticism or are discredited, and my work seems to have escaped observation. Von Eiselsberg [18] performed on two cats extirpation of both lobes in two acts. Seven and fourteen days intervened between the acts in these cases. That hypertrophy of the remaining lobe might not take place we can readily understand; the time was almost too short. He believes, however, that there was "évidente hypertrophie" in four of fourteen transplantation experiments. I am inclined in this instance to doubt the observations of this excellent investigator, because (1) he trusted to naked eye appearances, and (2) the time which elapsed from the removal of the first lobe for transplantation to the removal of the second was too short (3, 4, 4, 11, 11, 14, 15, and 15 days) for the development of this hypertrophy. The diagnosis of hypertrophy cannot be made with the naked eye. There are certain structural changes which are uniform and constant in hypertrophy and without which we cannot venture to assert that it is present. Even if there were no changes in structure, the naked eye, handicapped by memory, might easily make a wrong estimate as to size. Furthermore, an absolute increase in volume and weight might be due alone to tissue infiltration. Hypertrophy of the thyroid without change of structure at some period of its evolution is, as I have said elsewhere, inconceivable. Apparently the only observations of von Eiselsberg in this series which were controlled by the microscope were the only ones in which he would have been at all likely to encounter hypertrophy, and in these he says it was not present. I refer to two cases in which the intervals between the operations were 21 and 115 days. Von Eiselsberg's description of the microscopic appearances in the latter case interests me very much. He describes conditions which in the dog would indicate hypertrophy—at least an early stage of it.

He says, "The injected material (artificial injection of the blood vessels) penetrated everywhere even into the transplanted (between peritonaeum and fascia) gland in which, as in normal animals, the dendritic branching of the vessels could be observed." "In some places the colloid degeneration which often occurs normally was to be found in the interior of the vesicles." This dendritic branching of the blood vessels is one of the characteristic structural changes in the hypertrophied gland of the dog, and produces or keeps pace with the production of the involutions into the follicles. What von Eiselsberg designates as colloid degeneration is possibly the change in

[18] Anton Eiselsberg: Ueber Tetanie in Ausschlusse an Kropfoperationen. Wien, 1890, Alfred Halden.

the colloid which we always observe in hypertrophy. It becomes thin and vacuolated, and after a time disappears entirely.

Wagner [19] is regarded as the authority for the generally accepted notion that the thyroid gland hypertrophies after a part of it has been removed. In support of his views he has only two observations to offer, one upon a dog and one upon a cat. In the case of the dog, 35 days intervened between the first and second operations. The lobe which was supposed to be hypertrophied had 35 days for the development of the hypertrophy. Wagner does not give the date of the second operation upon the cat, hence we do not know how long a time the cat's thyroid had in which to become hypertrophied. We know (see Table No. IV) that hypertrophy is possible in 15 days, but we consider such early hypertrophies as exceptional. It is more than probable that Wagner observed hypertrophy in the case of the dog, although a microscopic examination of the gland was not made. His description of the enlarged thyroid arteries is quite convincing. I have repeatedly made the same observation, viz., that the thyroid blood vessels, arteries and veins, of the hypertrophied lobe seem to be dilated or enlarged. But one cannot make a positive diagnosis of hypertrophy from the naked eye appearances. At one time, after considerable practice, I thought that I could, without the microscope, diagnosticate the existence of hypertrophy, but I discovered subsequently that my diagnosis was fallible. I believed that a certain succulence, due, so I thought, in part to the high epithelium and perhaps principally to an increase in vascularity, was characteristic of hypertrophy, particularly when at the same time the color of the gland indicated an unusually great blood supply. But I have found microscopic evidence of advanced hypertrophic changes in glands that seemed to be unusually hard and that looked more anaemic than the normal gland. Hence the microscope must, as I have said elsewhere, be our criterion of hypertrophy.

The Structure of the Hypertrophied Thyroid Glands

In the normal gland of the dog the follicles as they appear in section vary in size more than in shape. They incline to roundness in shape, are lined by a single layer of cubical, sometimes almost flat epithelium, and are filled with an apparently homogeneous substance called colloid. This colloid material is semisolid in the normal gland and seems to distend the follicles. Even in the hardened specimen a cleft between the colloid and the cells which line the follicle is exceptional.

The thyroid gland is richly supplied with blood vessels. Each follicle is embraced by a vascular network. The distribution of the small vessels and capillaries assists one greatly in the interpretation of the minute anatomy

[19] Wien. med. Blätter, No. 30, 932.

of the hypertrophied gland. Even in the normal gland the blood vessels sometime unravel an interfollicular puzzle. They indicate, for example, the primitive follicles where they surround a few epithelial cells, and sometimes in this way they differentiate for us epithelial cells in what might otherwise seem a jumble of interfollicular cells without arrangement (see Plate LXXVII, 2).

We look to the epithelium (perhaps also to the colloid) for the first indication of hypertrophy, and sometimes find in one gland all of the stages of transition from low cubical to high cylindrical epithelium. How rapidly these changes may take place we cannot as yet say. Coincident with the increase in the height and breadth of the epithelium are changes in the colloid material and in the shape of the follicles. The follicles lose their roundish form and acquire increasingly irregular contours. Little bud-like processes sprout from the walls of the follicle. These sprouts seem to be a folding in (involution or plication) of the wall. The circumference of the follicle necessarily increases to accommodate the epithelium as it becomes broader. If the formation of normal colloid kept pace with the changes in the epithelium we might expect to have tremendous follicles still distended with colloid and retaining their more or less circular shape. But the colloid substance vanishes as the hypertrophy advances. It becomes vacuolated and apparently very thin, and eventually disappears or is represented by a delicate reticulum (*vid.* Plates LXXV, LXXVI, 2, and LXXVII, 4).

There seems to be no intrafollicular resistance. The wall of the follicle, very much longer than it was when lined with low epithelium, accordingly becomes folded upon itself. Little undulations and buds and digitations, short and long, appear. These involutions or digitations are oftener simple than compound. Sometimes they have several processes or branches. The shape of the central cavity of a follicle is the reverse cast, we may say, of its involutions. It is often roughly star-shaped. Sometimes it is like a bay with many short branching estuaries. In the very advanced hypertrophy the central cavity and its ramifications are pressed, so it seems, into elongated channels. These channels are often reduced to scarcely recognizable slits. It is then sometimes easier to differentiate the original follicle by the interfollicular blood vessels than by the intrafollicular canals. The central axis of each involution is occupied by blood vessels. The change backwards from hypertrophy to normal would be a simple matter. The shrinkage of the epithelium, the atrophy of the new—if indeed they are new—blood vessels, and the formation of normal colloid, would accomplish the transition.

Hypertrophy. The Time Required for its Development

In my second dog, and 71 days after excision of the left lobe, hypertrophy was discovered. One could not have failed to be surprised at the great size

of the right lobe, which weighed 2.5 grm., or more than four times as much as the left, the weight of which was 0.6 grm. The right lobe showed the histological and morphological changes which we soon learned to recognize as an advanced stage of hypertrophy. Not a vestige of normal thyroid structure remained.

Only a few of my experiments were made solely to determine the time required for the production of hypertrophy after excision of one lobe. Nevertheless we have a sufficient number of observations to justify the statement that if one thyroid lobe be excised in whole or in part, or mutilated, however slightly, hypertrophy of the other lobe will, to a greater or less degree, almost surely supervene within 40 days, and sometimes much earlier than this.

To estimate the time required for the development of the hypertrophy we must exclude, I am convinced, most of the dogs whose wounds were closed and then dressed with a plaster of Paris bandage—a bandage which, as I have explained, encircled the neck and confined the shoulders and upper part of the forelegs. The operations upon the dogs so treated were as follows: thirteen isolations of the left lobe, or one-sided Munk's operations; four extirpations of the left lobe followed immediately by substitution transplantations;[20] one manipulation enucleation[21] of the left lobe, and one extirpation of the left lobe.

The wounds healed absolutely per primam[22] in all of the cases except two (dogs 48 and 69). In one of these cases (dog 69) the suppuration was entirely superficial and very slight. Nevertheless most of the nineteen dogs so treated (closed wounds and plaster of Paris dressings) developed soon after operation peculiar symptoms and died, whereas the dogs with open wounds were perfectly well even when reduced to one-fourth and less of the

[20] The lobes of two dogs are exchanged and transplanted accurately *in situ*.

[21] The gland is raised out of its bed somewhat roughly, its loose connective tissue attachments are torn through, and it is then dropped back into place. Its principal blood vessels are not injured.

[22] I attribute the excellent results in wound-healing to the buried skin suture, "subcuticular suture." Only a small proportion of my wounds in dogs healed before I devised this suture. To take the stitches, the needle is first passed into the under surface of the skin as near to the deeper angle of its cut edge as possible, and including only the deeper layers of the skin, is made to emerge in the same plane. Sebaceous follicles and hair follicles should not be perforated by the stitches. We now use the continuous, buried skin suture in preference to the interrupted suture. Knots are unnecessary, because the tissues hug the uninterrupted suture so closely that slipping does not occur. Long ends of the uninterrupted silk or silver suture emerge at the angles of the wound, to make easy its withdrawal at the end of ten days or two weeks. If catgut is used the suture is not, of course, withdrawn, and may be tied. This suture was first described in The Johns Hopkins Hospital Bulletin, Vol. 1, p. 13.

thyroid gland (*vid.* Tables III and IV). The most striking symptoms which the dogs with plaster of Paris dressings developed were a profound anaemia, a peculiar scurvy-like condition of the gums and a falling out of the hair. The dogs would become exceedingly anaemic a few days after the operation, and within a week or ten days of the operation the affection of the gums would manifest itself. This scurvy-like condition of the gums was so severe in several instances that the body of the lower jaw was entirely denuded except at its lower border. An excessively foul-smelling breath accompanied this condition of the gums. Nine of these dogs died within twenty-five days (*vid.* Table IV): on the 15th day 1, on the 17th day 1, on the 18th day 2, on the 20th day 3, on the 24th day 1, on the 25th day 1. The right lobes of the nine dogs obtained post mortem showed, with two exceptions (dogs 58 and 68),[23] no perceptible change in structure, but the follicles of these glands were in greater part filled with cells—cells which clearly had their origin in the epithelium which lined them. Another dog of this group (No. 72) which died on the 39th day with the same symptoms had a thyroid gland (right lobe) which showed the described change—follicles filled with cells.

These ten cases died from the isolation or extirpation of one thyroid gland, which under ordinary conditions are harmless procedures. The profound anaemia, the scurvy of the gums and the sudden and very rapid falling out of the hair must be ascribed, I believe, as well as the fatal results, to diminished functional activity of the remaining lobe of the gland. A perverted functional activity is indicated perhaps by the proliferation of the cells of the follicles.

Of the nine remaining cases of this plaster of Paris group, one (dog 56) died on the 65th day. Four days after the removal of the left lobe he developed the tongue tremor, which is always seen when both lobes have been extirpated. This tremor subsided in two or three days. But already a conjunctivitis and central corneal ulcer of the left eye had developed. Within a month the dog became exceedingly anaemic; his gums were discolored at the edges, separated from the jaws, and beginning to slough. Before his death there was complete loss of hair. It is to be observed that this dog soon after the first operation had symptoms of extirpation of both thyroid lobes, that he recovered from these and lived altogether 65 days after the operation. The right lobe, obtained post mortem, was unmistakably hypertrophied to a certain extent (*vid.* Table IV); the epithelium was cuboidal or cylindrical, and the follicles were somewhat angular and contained the thin reticulated colloid material.

[23] Dog 58, early stage of hypertrophy on 15th day. Dog 68, early stage of hypertrophy on 25th day.

Seven dogs of the plaster of Paris group recovered perfectly from the operation: four (77, 43, 55, 2) without, at any period, a symptom; three (69, 70, 45) with temporary symptoms of thyroid privation. The remaining lobes of all of these seven dogs were hypertrophied to an advanced degree. One dog (67) of this group remains to be considered. He had not been well at any time since the first operation, and was very much emaciated when, on the 61st day after the first operation, the right (remaining) lobe was removed. The right lobe was perfectly normal. It was not hypertrophied, as we should have expected it to be had the dog made a good recovery from the first operation, nor were its follicles filled with cells, as we might, possibly, have expected them to be if the dog had died from the first operation. It is evident, therefore, that to estimate the time required for the development of the hypertrophy, we must exclude most of the dogs whose wounds were closed and dressed with a plaster of Paris bandage. Four of these dogs, however, as we have seen, made a perfect recovery from the first operation and without a symptom of thyroid privation.

Including these four we have thirty-six unquestionable observations on which to base our conclusions: dogs 116, 110, 118, 120, 121, 108, 119, 124, 88, 125, 122, 123, 112, 93, 92, 109, 87, 81, 86, 105, 83, 77, 103, 96, 43, 55, 2, 91, 104, 84, 82, 90, 94, 85, 126, and 127 (*vid.* Table IV).

Three hours was the shortest interval between the first and second operations, and 152 days the longest. The intermediate intervals were 24 hours, 4 days, 7 d., 7 d., 10 d., 10 d., 13 d., 15 d., 17 d., 19 d., 19 d., 22 d., 26 d., 42 d., 43 d., 49 d., 50 d., 50 d., 51 d., 53 d., 56 d., 57 d., 63 d., 67 d., 69 d., 70 d., 71 d., 71 d., 82 d., 82 d., 85 d., 95 d., 104 d., 132 d., 132 d. No change was observed until the seventh day, and this was a barely perceptible change (*vid.* dog 120, Table IV). It was observable in one only of the two seven-day observations. In one of the two ten-day observations an undoubted but very slight increase in the height of the epithelium was noted. On the 15th day quite advanced hypertrophy followed the extirpation of the inferior half of the left lobe.[24] An early stage of hypertrophy of both lobes on the 17th day followed ligation of everything at the upper poles except the arteries. We have two right lobes removed 19 days after the extirpation of the left lobe. One is normal, the other is very slightly hypertrophied (*vid.* Table IV). On the 22d day after extirpation of the left lobe we find a normal right lobe. A perfectly normal remaining lobe later than 22 days after extirpation or isolation of the first we have not seen.[25]

[24] One of the dogs dressed with plaster of Paris also showed an unmistakable hypertrophy on the 15th day.

[25] Dog 67 is the only exception, and this we have excluded for reasons already given.

The specimens of the 26th, 42d, and 43d days show early hypertrophy. Dog 92, from which the 42-day specimen was taken, furnished a most interesting piece of thyroid tissue at the unexpected autopsy. The first operation on this dog was the extirpation of the inferior half of the left lobe. Forty-two days later, the dog being apparently perfectly well, the remainder of the left lobe and the inferior half of the right were removed. These pieces we must remember were very slightly hypertrophied, although not apparently increased in size. The epithelium was higher than that of the piece excised at the first operation (the inferior half of the left lobe), but the colloid was still present in its usual form; there were no involutions, and the shape of the follicles was not much changed—on the whole, then, only a feeble or unsuccessful attempt at hypertrophy. As a rule, a dog not only survives this second operation, but has no symptoms of thyroid privation from it. Dog 92, however, died within four days of the second operation. The remainder of the thyroid gland, the superior half of the right lobe, obtained at the autopsy, presented the picture with which we have become so familiar in the dogs with closed wounds and plaster of Paris bandages, which died after extirpation or isolation of one lobe. The follicles were everywhere completely filled with disarranged cells, cells which had evidently been rapidly proliferated. The original follicles could be traced with difficulty and, as a rule, only by the blood vessels. There was no evidence of an advance towards a true hypertrophy.

Dog 96 furnishes another specimen of this peculiar change, which for the present we designate merely as follicles filled with cells. In this instance the superior half of the left lobe was removed. The wound was left open. The dog was apparently perfectly well for about 40 days, then became sick and died on the 63d day after the operation. The right lobe was tremendously hypertrophied, weighing 3.6 grms. With the microscope, the changes which indicate advanced hypertrophy were present, and in addition the follicles and the follicular channels [28] were filled with cells.

We are convinced that this apparently rapid proliferation of cells within the follicles cannot be a postmortem change. It is inconceivable that such striking morphological changes should be accomplished by postmortem cell exfoliation. There seems to be a great increase in the number of the cells in the cases under consideration. Furthermore, these experiments were, for the most part, conducted in winter and many of the autopsies were made soon after death. All specimens obtained later than 43 days after the extirpation of the whole or one-half of one lobe showed without exception the changes which we designate as advanced hypertrophy. In two instances

[28] In the very advanced stage of hypertrophy the follicles, as I have said, have lost their circular outline on section, and are drawn out into fantastic shapes and channels.

(dogs 103[27] and 104) manipulation enucleation, accomplished without injury to the principal arteries and veins of the gland, was followed by hypertrophy of both lobes in 57 and 82 days after the experiment.

A ligation of everything at the upper poles of both lobes except the principal arteries (dog 105), produced no structural changes in the gland in 51 days.

Ligation of the left lobe 2 or 3 mm. above the inferior tip was practised twice (dogs 126 and 127).[28] One hundred and thirty-two days after this experiment the left lobe and a portion of the right (inf. $\frac{1}{3}$) were removed from each of the dogs, and found in one (126) to be fully hypertrophied and in the other (127) to be perfectly normal.

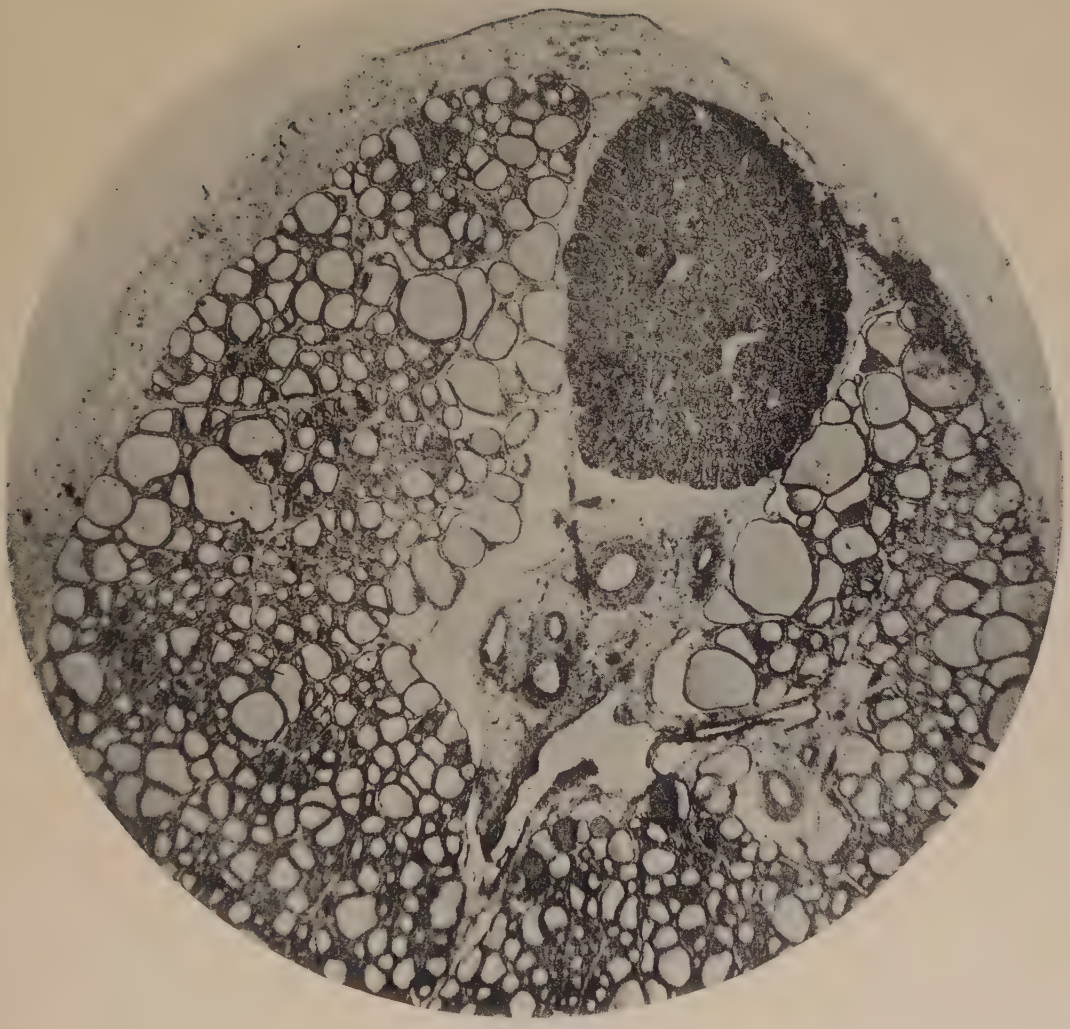
In March, 1895, Gley[29] described certain cellular changes which take place in the "glandules thyroidiennes" after thyroidectomy in the rabbit, and wonders if the observed changes are to be considered as transitional and as the first phases of an evolution which will ultimately give to the entire glandule the structure of the thyroid gland. He and Nicolas have been more fortunate than others, if they have observed in two cases (6 and 7 days after thyroidectomy) karyokinetic figures[30] in the glandules thyroidiennes. It had, they say, for some time been considered that the glandules became hypertrophied after thyroidectomy, but no one hitherto had succeeded in discovering any histological changes or positive multiplication of cells to explain an increase in the size of the glandules. Our observations on hypertrophy would lead us to believe that whatever the final change in the glandules thyroidiennes (parathyroid glandules) after thyroidectomy might be, the transformation to follicles filled with colloid would certainly not be an early manifestation. The colloid material is possibly a reserve secretion which is called upon to supply the requirements of the organism so soon as it is deprived of a part of the gland. If this is so, the balance is not under all circumstances nicely adjusted, for cutting off the tip of one lobe stimulates to tremendous hypertrophy of both the lobes and the accessory glands and exhausts the reserve supply of colloid. It is accordingly conceivable

[27] Notwithstanding the apparently tremendous hypertrophy, dog 103 died with typical symptoms of thyroid privation. The increase in the size of the thyroid lobes in dogs 103 and 104 was due in part to parenchymatous haemorrhage. See full histories in text.

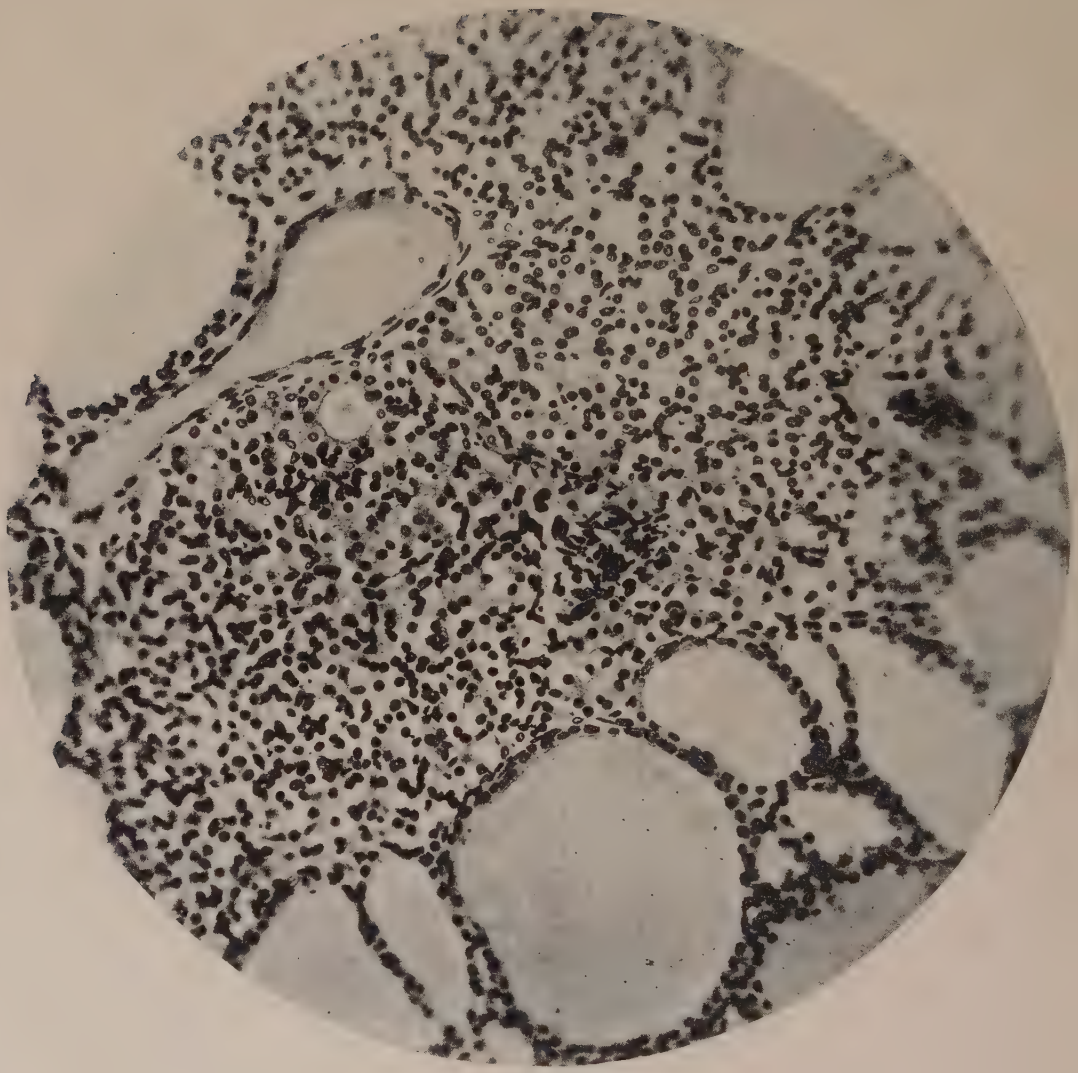
[28] The history of both of these dogs is given in full in the text. See also foot-note, page 114.

[29] Primières résultats de recherches sur les modifications histologiques des glandules thyroidiennes après la thyroidectomie. E. Gley and Nicolas, Comptes Rendu Hebdom.

[30] I have observed very few karyokinetic figures, even in the thyroid gland, although most of my glands were hardened in Flemming's sol. stained with safranin, and carefully studied for mitosis.

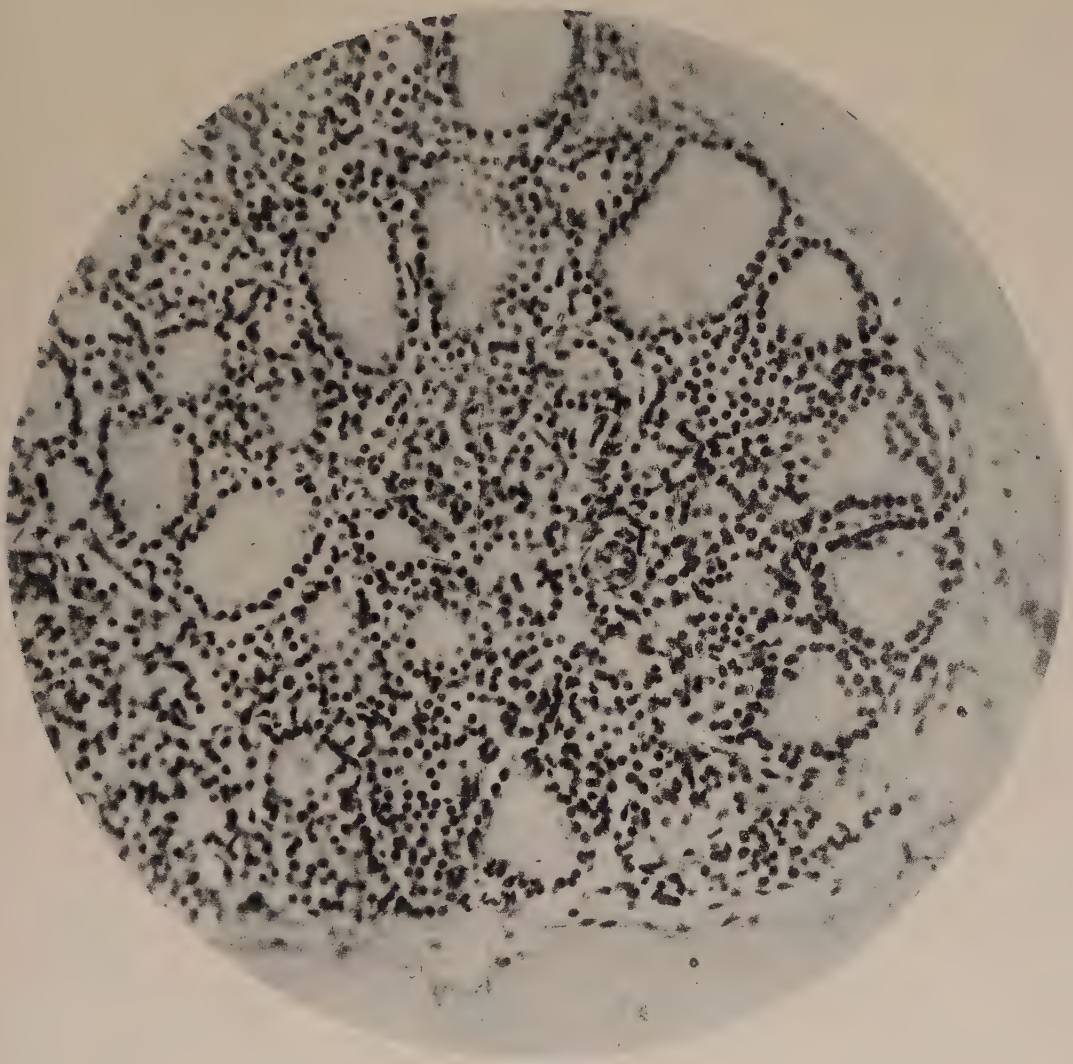


40 diameters.
PHOTOGRAPH I.



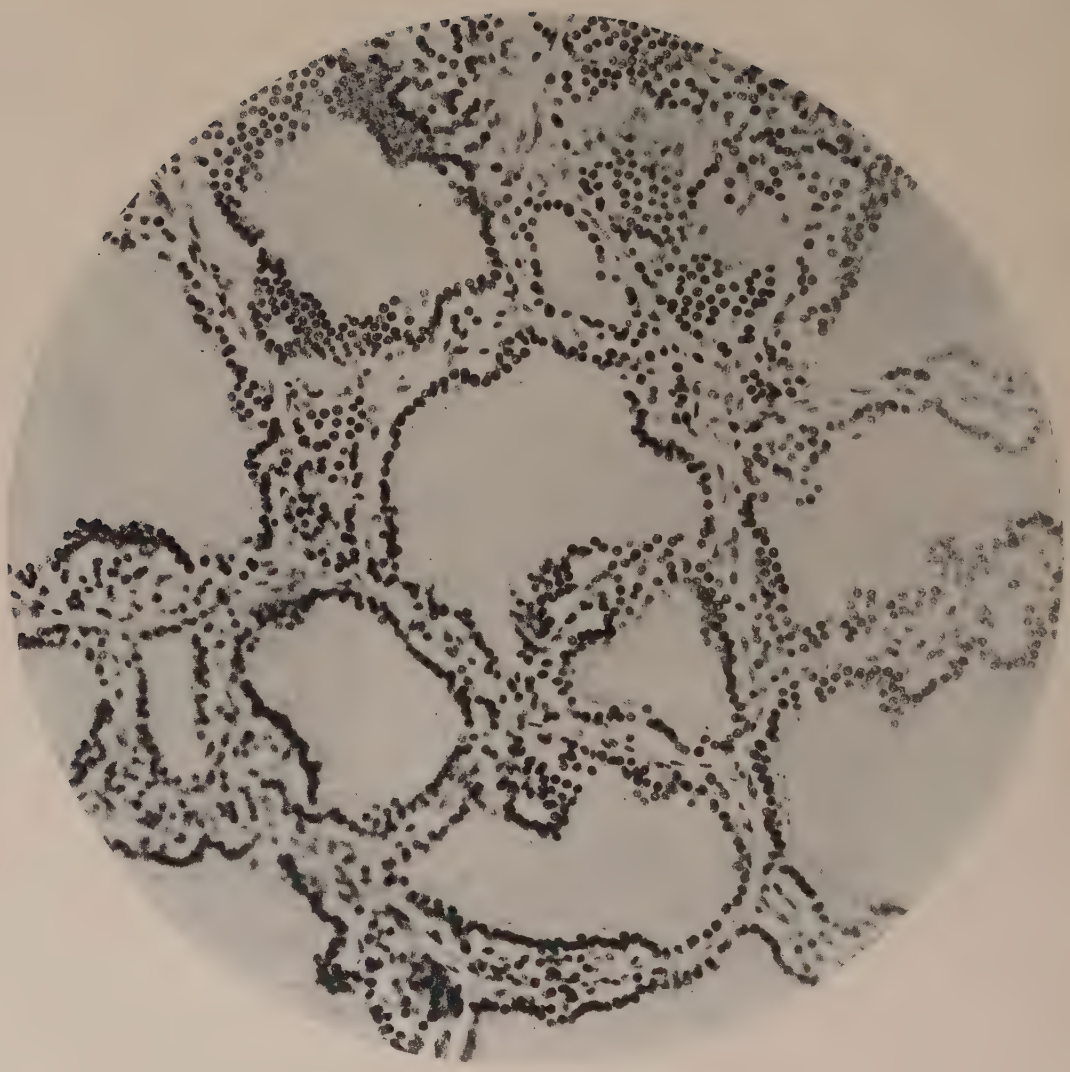
275 diameters.

PHOTOGRAPH II.



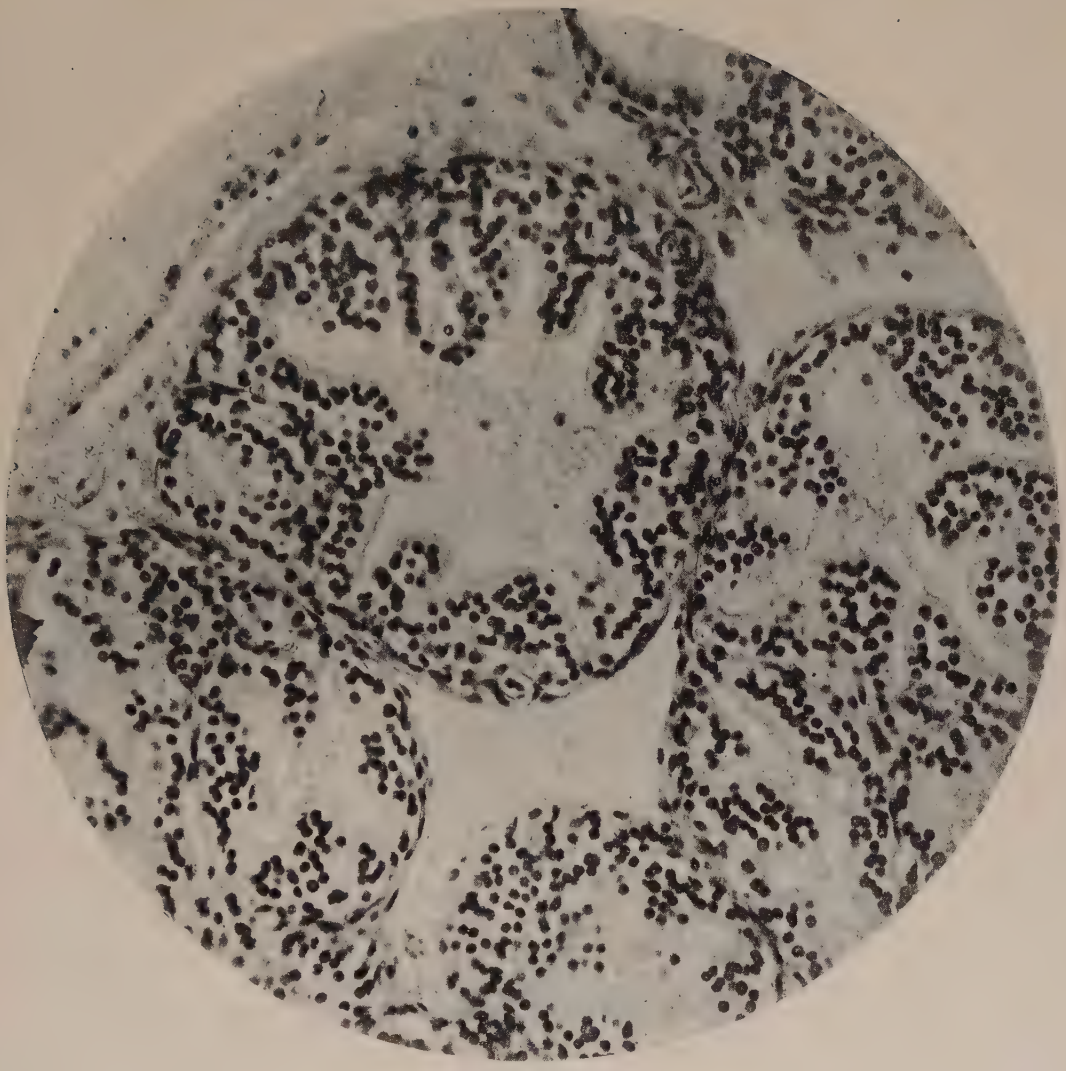
275 diameters.

PHOTOGRAPH III.



275 diameters.

PHOTOGRAPH IV.

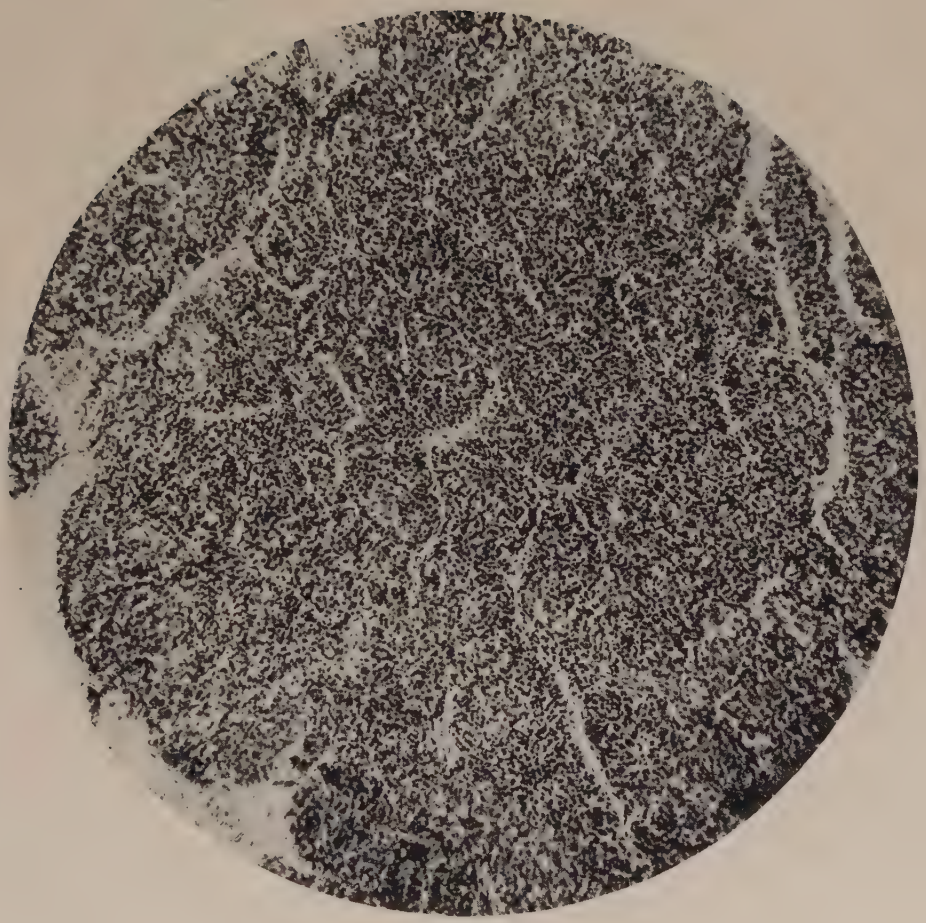


275 diameters.

PHOTOGRAPH V.

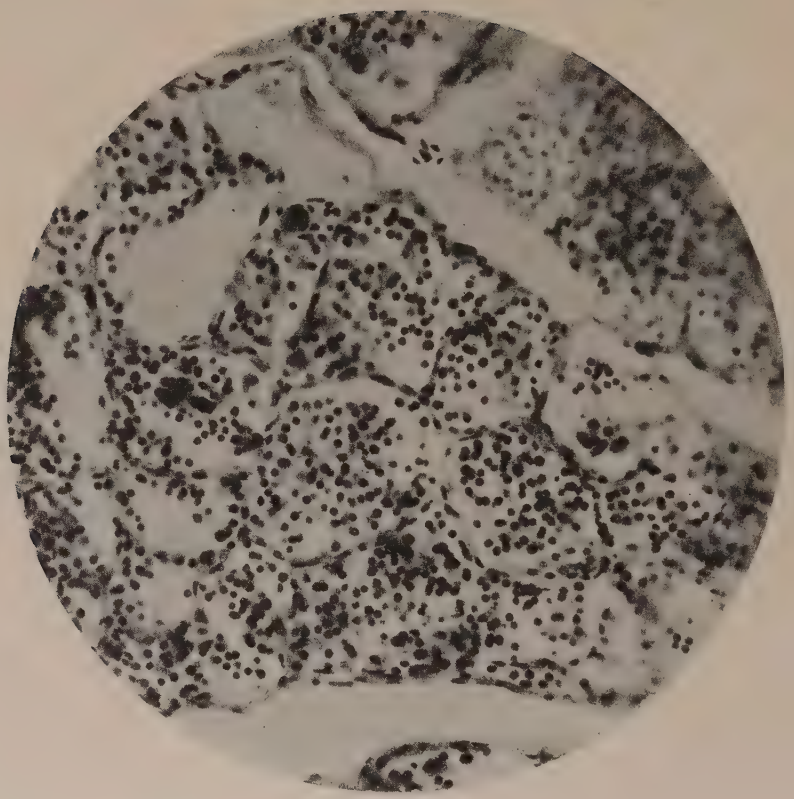
275 diameters.

PHOTOGRAPH VI.

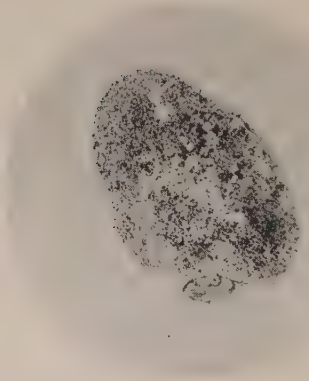


68 diameters.

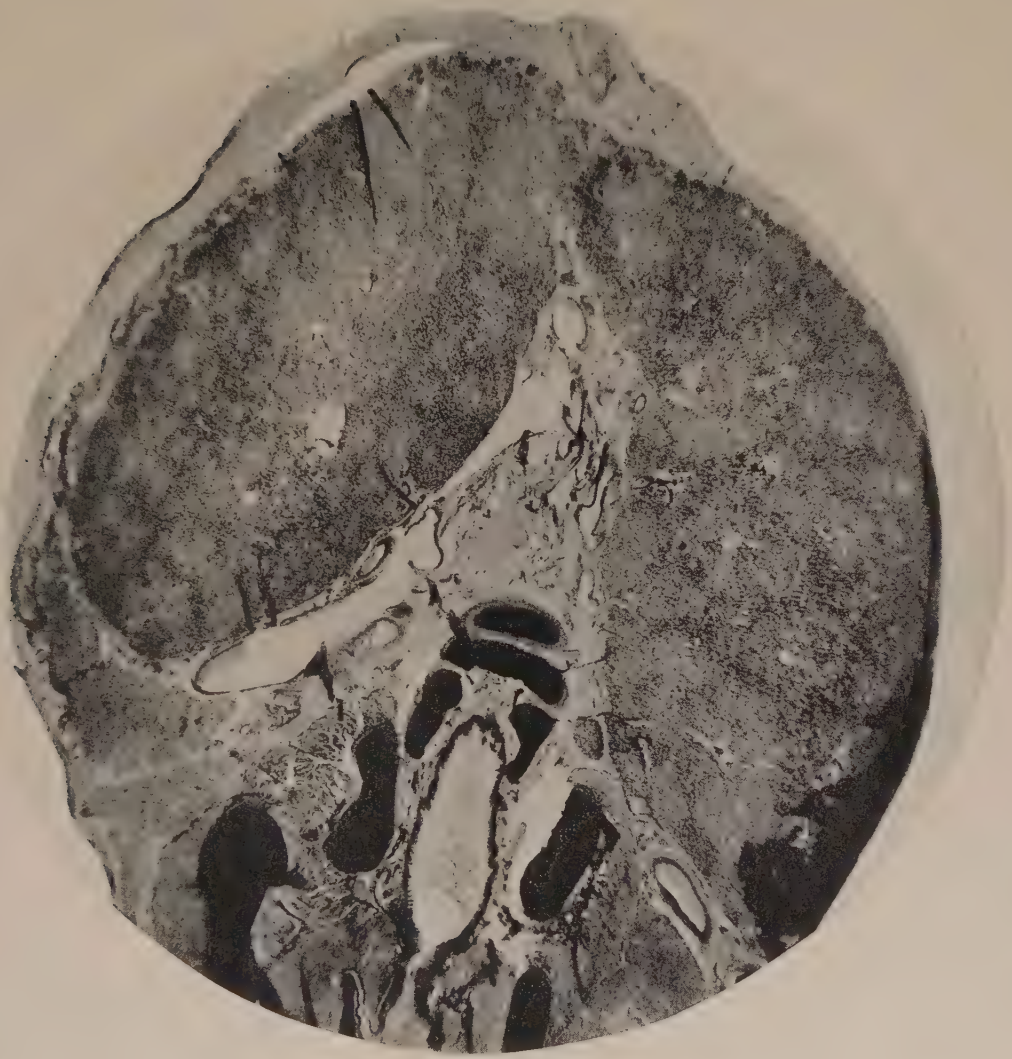
PHOTOGRAPH VII.



275 diameters.
PHOTOGRAPH VIII.



12 diameters.
PHOTOGRAPH IX.



12 diameters.

PHOTOGRAPH X.

that a transient autointoxication[31] might be caused by resection of a small portion of one lobe or by any manipulation which would induce hypertrophy. It is doubtful, however, if we should be able ordinarily to detect this intoxication, inasmuch as the hypertrophy and the coincident resorption of colloid take place as a rule so very slowly. In some dogs, however, hypertrophy develops quite rapidly, and in all the disappearance of the colloid is perhaps the earliest change.

I have said that the greatly hypertrophied glands of the puppies of parents deprived in part of the thyroid glands bear a striking resemblance in structure to the parathyroid glandule of dogs. In some instances it seems to be impossible to distinguish the one from the other.[32] The enormously hypertrophied thyroids of the puppies of bitch 97, for example, have neither colloid nor acini nor solid follicles, and present a structure which is, so far as one can judge from the specimens which I have preserved, identical with that of the parathyroid glandule.[33] Both parents of these puppies had been deprived in part of their thyroid gland. In the two instances in which only the female parent was subjected to a partial thyroidectomy, the hypertrophied glands of the puppies had still in some places small follicles filled with colloid, but for the most part there was little left to remind one of the original structure. It happens, fortunately, that the parathyroid glandule appears in several of my sections of normal and hypertrophied thyroid glands of adult dogs. I can, therefore, assert quite positively that no structural change took place in this glandule after partial extirpations of the thyroid lobes.

Furthermore, I cannot believe it to be a fact that dogs regularly survive the removal of the entire thyroid gland provided that the "glandules thyroidiennes" (parathyroid glands) are enucleated and left in place—to say nothing of the difficulty of such an experimental feat.

DESCRIPTION OF PLATES

Thyroid Glands of Dogs

Plate LXVII.—40 diameters. Normal gland. Shows a parathyroid glandule near the hilus of the lobe. Just at this point one sees the projection inwards of the delicate capsule of the lobes, embracing first the parathyroid lobule and then supporting the large blood vessels. The follicles are filled with the colloid material and are lined with a single layer of low cuboidal epithelium. In a few of the follicles, particularly

[31] Could resorption of this material during the operation explain some of the many deaths which occur during or soon after operations for exophthalmic goitre?

[32] I attach little, if any, importance to this resemblance of the greatly hypertrophied glands of the new-born puppies to the parathyroid glandules.

[33] Photo. I shows parathyroid glandule magnified 40 diameters.

the larger ones, the colloid material has apparently contracted and drawn away from the epithelium. As a rule the follicles are not merely filled, but seem to be distended with colloid.

PLATE LVIII.—275 diameters. Normal thyroid gland. Shows in the centre one of the more solid and so-called interfollicular portions of the gland. The cells of the interfollicular portion are for the most part epithelial and are grouped like young or very small follicles with little or no colloid. The long nuclei of the minute blood vessels assist one to differentiate the immature or interfollicular follicles.

PLATE LXIX.—275 diameters. Early stage of hypertrophy. High epithelium, rarefied (vacuolated) colloid. Angular follicles. In centre solid area of gland.

PLATE LXX.—275 diameters. Right thyroid only 17 days after excision of left. Hypertrophy more advanced than in Plate LXIX. Epithelium already cuboidal in most follicles. The vesicles are irregular in shape. The irregularity is due to a tendency to wave involutions. The colloid substance is abnormal. The nuclei of the blood vessels well shown in this photograph.

PLATE LXXI.—275 diameters. The follicles, except the central one, are almost completely filled by the involutions of the high (cylindrical) epithelium. The epithelium may be traced uninterruptedly from involution to involution. In this section the vessels have, for the most part, been divided transversely. They are easily recognizable at the bases of the involutions of the central follicle by the long nuclei. In several of the vessels blood corpuscles are to be seen. The colloid material is reduced to little more than vacuoles and a reticulum. The central cavities in this stage resemble very irregular bays with numerous estuaries, single, bifurcated, trifurcated, etc.

PLATE LXXII.—275 diameters. Inferior half of right thyroid. Dog 92. An almost normal gland; but probably a very early stage of hypertrophy 42 days after resection of inferior one-half of left. The shape of the follicles and the higher epithelium indicate beginning hypertrophy.

PLATE LXXIII.—68 diameters. Superior half of the right lobe of dog 92. The inferior half of the very same lobe removed only four days previously is shown in Plate LXXII. The dog died very unexpectedly after the removal of the remainder of the left lobe and the inferior half of the right lobe. The wound, treated by the open method, was healthy. Aside from the inflammation the change in the gland is most striking. The follicles are completely filled with cells. These cells are evidently of epithelial origin and were proliferated or exfoliated in four days at most.

PLATE LXXIV (Photo. 8).—275 diameters. From one of the cases with closed wound and plaster of Paris dressing. Follicles filled with cells.

PLATE LXXIV (Photo. 9).—12 diameters. Normal gland of new-born puppy, shows two accessory lobules. The one which projects so prominently from the surface is a so-called parathyroid glandule. The other, adjoining and to the left of the first, is thyroid tissue, but without colloid.

PLATE LXXV.—12 diameters. Hypertrophied gland of new-born puppy of dog 97. About twenty times as large (both lobes) as normal gland.

PLATE LXXVI, 1.—90 diameters. Normal gland. Gives the correct idea of the shape of normal follicles. Most of the follicles are filled with colloid. Some are empty. The epithelium is flat.

2.—530 diameters. Two follicles of a hypertrophied gland. The epithelium is cylindrical and in places several rows deep. The colloid material is replaced by vacuoles and a reticulum. The follicles are distinctly defined by the long nuclei of the blood vessels.

3.—530 diameters. One follicle of normal thyroid gland of dog. The orange color indicates blood.

4.—925 diameters. A portion of central canal of hypertrophied follicle, with longitudinal or slightly oblique section of involution on the right hand, and transverse sections of involutions on the left. The blood discs in orange indicate the situation of the capillaries.

PLATE LXXVII, 1.—240 diameters. Injected specimen. Hypertrophy. The injection has reached the terminal ramifications of the blood vessels in the involutions. In several instances the follicles are seen to be almost completely surrounded by blood vessels. The epithelium is cuboidal. The colloid is replaced by the reticulum.

2.—240 diameters. Injected specimen. Hypertrophy. A more solid part of the gland which might be called (erroneously) interfollicular were it not for the injection. The injection defines follicles which have no central canal and which might be termed solid. It also differentiates the intra- from the interfollicular spaces. Compare with Plate LXXVII, 3.

3.—240 diameters. Hypertrophy. Same stage as Plate LXXVII, 2. Designed to show the solid and very advanced stage of hypertrophy. The nuclei of the blood vessels have unintentionally been omitted by the artist. It is interesting to note the confusion caused by the omission. Compare Plate LXXVII, 2.

4.—240 diameters. Advanced hypertrophy. Natural injection indicated by daubs of orange. One large and ten or twelve small follicles. Colloid replaced by reticulum in all the folicles.

5.—*a*. Usual size of one lobe of dog's thyroid at birth as estimated from three litters of puppies (from 15 to 18 puppies).

c. Actual size of thyroid gland of puppy whelped by bitch No. 97 when she had been deprived of her left lobe, and sired by dog No. 90, whose thyroid had been reduced to two-thirds of one lobe. See history of No. 97.

b. Left lobe of dog No. 3. Actual size.

d. Hypertrophied right lobe of same dog (No. 3). Actual size.

ADDENDUM

After receiving the page-proof of this article, I had the good fortune, thanks to the courtesy of Dr. Abel, to make an autopsy upon a dog whose thyroid lobes had been removed *in toto* by him just a year ago. The dog emaciated rapidly after the loss of the thyroid gland, became profoundly anaemic, lost most of his hair,[34] seemed to suffer from a more or less constant itching, and developed by scratching a dermatitis which in some places might have suggested myxoedema. He never developed convulsions or tetany or tremors or any of the more pronounced symptoms of complete extirpation. Neither did he suffer from the scorbutic gingivitis which I have described as occurring in a special group of my cases.

He was fed with thyroid glands or thyroid extracts for two months, but not with any very appreciable effect. The autopsy was not performed until about 30 hours after the death of the animal.

[34] This dog was supposed to have mange before he was operated upon. The loss of hair and the dermatitis were perhaps due to this skin disease.

Autopsy.—Small dog seven years old, much emaciated and almost hairless. No lesions of the viscera macroscopically discoverable. The neck was dissected with great care. The thyroid lobes had undoubtedly been removed; not a trace of them remained. An accessory thyroid which is usually found behind the hyoid bone, on the thyro-hyoid membrane, was apparently wanting. This gland had been searched for by me during the life of the dog, but could not be found.

In the neighborhood of the arch of the aorta three or four very minute reddish-brown bodies were discovered which proved to be epithelial bodies, almost if not precisely identical in structure with the so-called parathyroid glandules. These little bodies were certainly not much more than one-quarter the size of the head of an ordinary pin. Under the arch of the aorta and very near the ductus Botali were three very large accessory thyroids, two of them as large as a very small pea. The three accessory thyroids weighed together .08 gramme. After examining with the microscope a number of sections of these accessory thyroids, I was impressed with the simplicity of their structure. Most striking was the fact that there were very few interfollicular cells. Almost all the cells were engaged in the formation of follicles, and all of the follicles seemed distended to their utmost with apparently normal colloid. The cells lining the follicles (and there seemed, as I have said, to be very few other cells) were a little higher than normal. There were rather numerous little epithelial buddings into the follicles, and in some of the buds blood vessels could be demonstrated.

We may assume with considerable confidence that these aortic accessory thyroid glands have passed through the changes which we describe as hypertrophic. Hypertrophy of the thyroid as we have represented it is probably a transition stage—transitional to the condition which makes possible the greatest fulfilment of functions in some (*i. e.*, Dr. Abel's dog) and a greater activity in all cases. How then shall we interpret what we see in these greatly enlarged aortic thyroids? The enlargement, it would seem, must be due in this instance either to an increase in the size of the original follicles or to an increase in the number of follicles containing colloid, or to both. It cannot be due alone to the inconspicuous increase in the size of the cells. This increase in the size of the follicles and in the number of follicles containing and distended with colloid implies not only a greater amount of colloid, but also either a greater number of cells than the gland originally contained, or a rearrangement of the original cells.

TABLE I.—EXTIRPATION OF BOTH LOBES

No. of animal	Description of animal	Date of operation	Treatment of the wound	Healing of the wound	Weight of the lobes	Date of death	Autopsy	Remarks
1. (30).	Medium sized old dog.	1, III, 1888.	* Buried skin sutures.	Per primam.	Left, 0.7 grm. Right, 0.7 grm.	7, III, 1888.	Negative.	Developed double conjunctivitis. Died with typical symptoms.
2. (31).	Medium sized old bitch.	1, III, 1888.	* Buried skin sutures.	Per primam.	Left, 2. Right, 2.	8, III, 1888.	Negative.	Typical symptoms.
3. (32).	Small young dog.	1, III, 1888.	* Buried skin sutures.	Per primam.	Left, 1. Right, 1.	17, III, 1888.	Negative.	Double conjunctivitis. Typical symptoms. Killed when nearly dead, to obtain fresh tissues.
4. (39).	Medium sized dog.	3, III, 1888.	* Buried skin sutures.	Wound apparently not infected. Too early for union.	Both lobes very small and pale.	5, III, 1888.	Negative.	Typical symptoms.
5. (40).	Small dog about 1 year old.	5, III, 1888.	* Buried skin sutures.	Per primam.	Left, 0.35. Right, 0.15. (Unusually small lobes.)	13, III, 1888.	Negative.	Dog not observed by me for the five days preceding his death.

* Antiseptic precautions, closed wound and plaster of Paris dressing.

TABLE II.—ISOLATION EXPERIMENTS (MUNK'S OPERATION)

No.	Description of animal	Date of operation	The treatment of the wound	The healing of the wound	Left lobe at autopsy	Right lobe at autopsy	Clinical history	Died	Autopsy	Transplantations	Total extirpations
1. (11).	Small dog aet. about 1 year.	17, II, 1888.	* Perforating skin stitches.	Suppuration.			Double keratitis. Died with typical total extirpation symptoms. Suppuration having occurred, this case is of no value as a transplantation experiment.	20, II, 1888.	Negative.	2	1
2. (12).	Medium sized dog.	17, II, 1888.	* Perforating skin stitches.	Absolutely per primam.	Not adherent.	Not adherent.	Died with typical symptoms.	20, II, 1888.	Negative.	2†	1
3. (13).	Medium sized bull dog.	17, II, 1888.	* Perforating skin stitches.	Suppuration.			Died with typical symptoms.	29, II, 1888.		2	1
4. (14).	Small young bitch.	21, II, 1888.	* Perforating skin stitches.	No union; but suppuration not evident.	Not adherent.	Not adherent.		27, II, 1888.	A greyish necrotic film lined the wound The solution of corros. sublimat. employed for irrigation was probably too strong.	2	1
5. (15).	Large old dog.	21, II, 1888.	* Perforating skin. stitches.	No union; but suppuration not evident.	Not adherent.	Not adherent.		24, II, 1888.	Same as preceding case.	2	1

6. (16).	Medium sized dog about one year old.	24, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Necrotic.	Absorbed.	Typical symptoms.	12, III, 1888.	In the neighborhood of right lobe the tissues are stained yellow by material composed of fat globules and needle-shaped fat crystals.	2†	1
7. (18).	Small bitch pup.	24, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Soft yellow necrosed mass.	Necrosed and almost absorbed.	Double conjunctivitis. Typical symptoms.	4, III, 1888.	Very small discrete areas of pneumonia throughout right lung. Other organs healthy.	2†	1
8. (19).	Small young bitch.	27, II, 1888.	* Buried skin stitches.	Wound apparently aseptic.	Not adherent.	Not adherent.		28, II, 1888.	Negative.	2	1
9. (20).	Large dog.	27, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Adherent to surrounding tissues.	Adherent to surrounding tissues.		2, III, 1888.	Negative.	2†	1
10. (21).	Small old dog.	27, II, 1888.	* Buried skin stitches.	Suppuration.	Not adherent and partially absorbed.	Not adherent and partially absorbed.	Convulsions observed only once (4, III).	6, III, 1888.	Double pneumonia.	2	1
11. (23).	Medium sized dog 3 or 4 years old.	28, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Adherent and necrosed.	Adherent and necrosed.	Typical symptoms.	12, III, 1888.	Negative.	2†	1
12. (24)		28, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Adherent and necrosed. Beginning organization new vessels.	Adherent and necrosed. Beginning organization.	Typical symptoms.	14, III, 1888.	Negative.	2†	1

* Antiseptic precautions, closed wound and plaster of Paris dressing. † Healed per primam.

TABLE II.—CONTINUED

No.	Description of animal	Date of operation	The treatment of the wound	The healing of the wound	Left lobe at autopsy	Right lobe at autopsy	Clinical history	Died	Autopsy	Transplantations	Total extirpations
13. (25).	Small dog.	28, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Firmly adherent and necrosed.	Firmly adherent and necrosed.	Typical symptoms.	3, III, 1888.	Negative.	2†	1
14. (26).	Small dog about 2 years old.	29, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Not adherent and atrophied.	Firmly adherent and necrosed.	Typical symptoms.	7, III, 1888.	Negative.	2†	1
15. (27).	Medium sized dog about two years old.	29, II, 1888.	* Buried skin stitches.	Wound filled with blood at autopsy.	Not adherent.	Not adherent.	Typical symptoms. Dog killed when moribund to obtain fresh nerve tissues.	6, III, 1888.	Negative.	2	1
16. (28).	Small old bitch.	29, II, 1888.	* Buried skin stitches.	Wound healed in deep parts. Slight suppuration in skin.	Adherent and necrosed.	Adherent and necrosed.	Typical symptoms.	5, III, 1888.	Negative.	2†	1
17. (29).	Medium sized young dog.	29, II, 1888.	* Buried skin stitches.	Absolutely per primam.	Adherent. Color greenish red. Mottled bluish red necrosed. A few preserved follicles at periphery.	Same as left lobe.	Typical symptoms.	12, III, 1888.	Negative.	2†	1
18. (53).	Old bitch.	12, III, 1888.	* Buried skin stitches.	Apparently not infected.				15, III, 1888.	Double pneumonia.	2†	1

19. (54).		12, III, 1888.	* Buried skin stitches.	Absolutely per primam.	Haemorrhagic veins tied first.	Same as left lobe.	Double conjunctivitis. Typical symptoms.	19, III, 1888.	Double pneumonia.	2†	1
20. (59).	Large bull dog.	14, III, 1888.	* Buried skin stitches.	Absolutely per primam.	Destroyed.	Destroyed.	Lived 62 days. Killed by other dogs and neck devoured. Hence no specimens.	15, V, 1888.	Negative.	2†	1
21. (60).	Small dog about 2 years old.	14, III, 1888.	* Buried skin stitches.	Haemorrhage in wound.			Double conjunctivitis. Typical symptoms.	20, III, 1888.	Negative.	2	1
22. (61).	Large dog about 3 years old.	14, III, 1888.	* Buried skin stitches.	Suppuration.			Typical symptoms.	19, III, 1888.	Fetid pleurisy by extension from neck wound.	2	1
23. (62).	Large old dog.	15, III, 1888.	* Buried skin stitches.	Suppuration.			Conjunctivitis of left eye. Symptoms of total extirpation.	21, III, 1888.	Negative.	2	1
24. (65).	Small young dog.	15, III, 1888.	* Buried skin stitches.	Absolutely per primam.			Symptoms of total extirpation. When almost dead was bled to death in a transfusion experiment.	20, III, 1888.	Negative.	2†	1
										22	
										26†	
										48	24

* Antiseptic precautions, closed wound and plaster of Paris dressing. † Healed per primam.

TABLE III.—PIECEMEAL RESECTION OF THE THYROID GLAND

No.	Description of animal	Resected at 1st operation	Examination of piece resected at 1st op.	Resected at 2d operation	Examination of pieces resected at 2d op.	Resected at 3d operation	Examination of piece resected at 3d op.	Resected at 4th operation	Examination of piece resected at 4th op.	Resected at 5th operation	Examination of piece resected at 5th op.	Died or killed	Examination of accessory thyroids and final piece	Remarks
1. (81).	Dog, aet. about 1 year.	4, X, 1888. Inf. ½ left lobe.	Normal.	23, XI, 1888. Sup. ½ left. Inf. ⅓ right.	50 days after 1st op. Left, 0.7 grm., hypertrophied. Right, 1.75 (estimate), hypertrophied.	30, IV, 1889. Middle ⅓ right.	158 days after 2d op. 208 days after 1st op. 1 grm. Hypertrophied.	9, VIII, 1889. Inf. ½ of sup. or remaining ⅓ of right.	101 days after 3d op. 309 days after 1st op. Hypertrophied.			24, VIII, 1889. Strangled by piece of meat lodged in pharynx.	324 days after 1st op. Suprasternal and aortic enlarged and hypertrophied.	
2. (82).	Bitch, aet. about 1 year.	13, X, 1888. Inf. ⅔ of left. lobe.	Wt. 0.6 (estimate). Normal.									6, I, 1889. Pneumonia.	85 days after op. Left, wt. 1.5, hypertrophied. Right, wt. 2.7, hypertrophied.	
3. (83).	Old dog.	13, X, 1888. Inf. ⅓ left.	Wt. 0.4 (estimate). Normal.	5, XII, 1888. Sup. ½ left. Inf. ⅔ right.	53 days after 1st op. Left hypertrophied. Right hypertrophied.							22, XII, 1889. Strangled by piece of meat lodged in pharynx.	70 days after 1st op. Sup. ⅔ right. Hypertrophied.	
3. (84).	Dog, aet. about 1 year.	17, X, 1888. Inf. ½ left.	Normal.									7, I, 1889. Killed to make injection of right lobe.	82 days after op. Sup. ½ left, large and hypertrophied. Right, large and hypertrophied.	
5. (85).	Small old bitch.	17, X, 1888. Inf. ⅔ left.	Wt. 0.25. Normal.	29, I, 1889. Sup. ½ left. Inf. ⅔ right.	104 days after 1st op. Moderate hypertrophy. Colloid still in many follicles. Fig. 7.							8, II, 1889. Killed by other dogs.	Destroyed by dogs.	
6. (86).	Medium sized dog, aet. about 2 years.	23, X, 1888. Inf. ⅓ left.	Wt. 0.6. Normal.	12, XII, 1888. Sup. ⅓ left. Inf. ½ right.	50 days after 1st op. Left, wt. 2. (est.), hypertrophied. Right, wt. 1. (est.), hypertrophied.	12, II, 1889. Inf. ½ of remainder of right (2d, 4th).	62 days after 2d op. 112 days after 1st op. Hypertrophied.	28, IV, 1889. Inf. ½ of rest of right (2d, 8th).	75 days after 3d op. 187 days after 1st op. Hypertrophied.			19, V, 1889. Symptoms character of thyroid extirpation.	Several unusual accessory thyroids. *Vid.* history. All hypertrophied.	Lived 21 days with only ⅓ of both lobes.

7. (87).	Medium sized full grown dog.	23, X, 1888. Inf. $\frac{1}{2}$ left.	Wt. 0.3 Normal.	11, XII, 1888. Sup. $\frac{1}{2}$ left. Inf. $\frac{1}{2}$ right.	49 days after 1st op. Left, moderate hypertrophy. Right, moderate hypertrophy.							17, XII, 1888. Killed when dying.	Remainder of right lobe had sloughed.
8. (88).	Small young bitch.	23, X, 1888. Inf. $\frac{1}{2}$ left.	Wt. 0.25. Normal.									7, XI, 1888. Killed to make injected specimens.	15 days after op. Sup. $\frac{1}{2}$ left, hypertrophy well marked. Right, hypertrophy well marked.
9. (89).	Small bitch, aet. about 1 yr.	26, X, 1888. Inf. $\frac{1}{2}$ left.	Wt. 0.4. Normal.									3, I, 1889. Pneumonia.	
10. (90).	Large strong dog aet. 2 or 3 years.	26, X, 1888. Inf. $\frac{1}{2}$ left.	Wt. 0.3. Normal.	29, I, 1889. Sup. $\frac{1}{2}$ left. Inf. $\frac{2}{3}$ right.	95 days after 1st op. Left hypertrophied. Right hypertrophied.	30, IV, 1889. Inf. $\frac{1}{3}$ of remainder right.	91 days after 2d op. 186 days after 1st op. Wt. 1.5. Hypertrophied.					21, VI, 1889. Probably too little thyroid.	238 days after 1st op. Wt. of rest of right 2. Hypertrophied.
11. (91).	Large dog aet. 2 or 3 years.	26, X, 1888. Inf. $\frac{2}{3}$ left.	Wt. 0.8. Normal.									5, I, 1889. Pneumonia.	71 days after 1st op. Follicles of remaining pieces filled with cells. No hypertrophy.
12. (92).	Small puppy dog aet. about 6 mos.	31, X, 1888. Inf. $\frac{1}{2}$ left.	Wt. 0.3. Normal.	12, XII, 1888. Sup. $\frac{1}{2}$ left. Inf. $\frac{1}{2}$ right.	42 days after 1st op. Left and right normal.							17, XII, 1888. No definite symptoms of thyroid extirpation.	Autopsy 2 days after death. Accessories and final piece decomposed.
13. (93).	Bitch, aet. about 3 years.	31, X, 1888. Inf. $\frac{1}{2}$ left.	Normal.									26, XI, 1888. Purulent pericarditis and pleuritis.	26 days after op. Early hypertrophy.
14. (94).	Small young dog.	31, X, 1888. Inf. $\frac{1}{2}$ left.	Normal.									7, II, 1889. Killed to make injected specimens.	99 days after op. Left and right hypertrophied.
15. (95).	Small puppy dog.	2, XI, 1888. Inf. $\frac{1}{2}$ left.	Normal.									Dog lost.	
16. (96).		2, XI, 1888. Sup. $\frac{1}{3}$ left.										4, I, 1889. Pneumonia.	63 days after op. Left, wt. 1.3, hypertrophied. Right, wt. 3.6, hypertrophied.

TABLE III.—CONTINUED

No.	Description of animal	Resected at 1st operation	Examination of piece resected at 1st op.	Resected at 2d operation	Examination of pieces resected at 2d op.	Resected at 3d operation	Examination of piece resected at 3d op.	Resected at 4th operation	Examination of piece resected at 4th op.	Resected at 5th operation	Examination of piece resected at 5th op.	Died or killed	Examination of accessory thyroids and final piece	Remarks
17. (97).	Small bitch, aet. about 1 year.	14, XI, 1888. Sup. $\frac{1}{3}$ left.	Normal.	12, XII, 1888. Intended to resect rest of left, but could find nothing but ligature of 1st op.		30, IV, 1889. Inf. $\frac{1}{2}$ right.	139 days after 2d op. 167 days after 1st op. Very large, spindle shaped. Hypertrophied.	11, XI, 1889. $\frac{1}{2}$ of lymph gland by mistake.	195 days after 3d op. 362 days after 1st op. Lymph gland.	6, I, 1890. Remainder of right after prolonged search.	56 days after 4th op. 418 days after 1st op. Small hard nodule. Hypertrophied.	14, I, 1890. With symptoms typical of thyroid extirpation.	426 days after 1st op. Accessories hypertrophied.	12, IV, 1889, bitch at full term. Convulsions yesterday and to-day, otherwise well and in good spirits. 13, IV, 1889, whelped five pups with tremendous thyroids. *Vid.* full history and 20 (127).
18. (98).														
19. (126).	Small bitch, aet. about 2 years.	11, XII, 1888. Ligation of left lobe about 2 mm. above inf. pole.	Nothing resected.	22, IV, 1889. Entire left and inf. $\frac{2}{3}$ right.	132 days after 1st op. Left, normal. (?) Right, early hypertrophy.	9, VIII, 1889. Inf. $\frac{1}{2}$ of remaining $\frac{2}{3}$ of right.	109 days after 2d op. 241 days after 1st op. Hypertrophy.	11, XI, 1889. Remainder (sup. $\frac{1}{10}$) of right.	93 days after 3d op. 334 days after 1st op. Hypertrophied.			11, XI, 1889. Killed by morphia at 4th op. Had been very weak for several weeks and would soon have died.	334 days after 1st op. Accessories hypertrophied.	
20. (127).	Medium sized pointer bitch, about 1 year old	11, XII, 1888. Ligation of left lobe about 3 mm. above inf. pole.	Nothing. resected.	22, IV, 1889. Entire left and inf. $\frac{1}{3}$ right.	132 days after 1st op. Normal.	11, XI, 1889. Middle $\frac{1}{3}$ right.	203 days after 2d op. 335 days after 1st op. Nearly normal.	14, I, 1890. Inf. $\frac{2}{3}$ of remaining sup. $\frac{1}{3}$ of right, (2d and 3d ninths.)	64 days after 3d op. 339 days after 1st op. Wt. 1.5 ($\frac{2}{3}$ of right). Hypertrophied.	Jan., 1891. Remainder (sup. $\frac{1}{3}$) of right. Lived 1 year with $\frac{1}{3}$ of both lobes.	2 years. and 1 mo. after 1st op. Specimen lost.	Jan., 1891. 3 or 4 days after 5th op. With typical symptoms of thyroid extirpation.	2 years and 1 mo. after 1st op. Accessories hypertrophied.	31, VIII, 1889. Has had convulsions and typical symptoms of thyroid extirpation for 2 days. Previously was quite well. Whelped 8 pups. *Vid.* No. 17, (97), and full history. Lived 1 year with $\frac{1}{3}$ of both lobes.

TABLE IV.—CONDITION OF UNDISTURBED (RIGHT) LOBE AFTER EXTIRPATION OF OR VARIOUS INSULTS TO THE OTHER (LEFT) LOBE

No. of dog	Operation	From first operation to removal of right lobe	Condition of right lobe	
1. (116).	Extirpation of left lobe. Open treatment of wound.	3 hours.	Normal.	
2. (110).	Extirp. l. lobe. Open treatment of wound.	28 hours.	Normal.	
3. (118).	Extirp. l. lobe. Open treatment of wound.	4 days.	Normal.	
4. (120).	Extirp. l. lobe. Open treatment of wound.	7 days.	Epithelium of right lobe higher than that of left lobe.	Slight changes in shape of follicles of right lobe.
5. (121).	Extirp. l. lobe. Open treatment of wound.	7 days.	Normal.	
6. (108).	Extirp. l. lobe. Open treatment of wound.	10 days.	Epithelium of right lobe somewhat higher than that of left lobe.	Epithelium of left lobe a little higher than normal.
7. (119).	Extirp. l. lobe. Open treatment of wound.	10 days.	Normal.	
8. (124).	Extirp. l. lobe. Open treatment of wound.	13 days.	Normal.	
9. (58).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*15 days.	Hypertrophy. High epithelium, angular follicles. Colloid absent. No involutions. Right lobe obtained post mortem.	Capillary buds not covered by epithelium project into follicles of right lobe. Extensive haemorrhages into left (necrotic) lobe. No tremors nor convulsions. Lungs normal. Scorbutic gums.
10. (88).	Extirp. inf. half l. lobe. Open treatment of wound.	15 days.	Hypertrophy quite advanced. Involutions.	
11. (79).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	17 days.	Normal, except that many of the follicles are filled with cells. Right lobe obtained post mortem, was white and hard.	No convulsions nor tremors. Autopsy negative.

* Died

TABLE IV.—Continued

No. of dog	Operation	From first operation to removal of right lobe	Condition of right lobe	
12. (125).	Ligation of everything at upper poles except the arteries. Open treatment of wound.	17 days.	Hypertrophy, early stage.	
13. (64).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*18 days.	Normal, except that follicles are filled with cells. Right lobe obtained post mortem.	Scorbutic gingivitis. No convulsions nor tremors. Autopsy negative.
14. (76).	Extirp. l. lobe and substitution transplantation. Closed wound. Plaster of Paris dressing. Healed per primam.	*18 days.	Normal. Follicles for the greater part filled with cells. Right lobe obtained post mortem.	Scorbutic gingivitis. No convulsions nor tremors. Autopsy negative.
15. (122).	Extirp. right lobe. Open treatment of wound.	19 days.	Normal.	
16. (123).	Extirp. l. lobe. Open treatment of wound.	19 days.	Epithelium slightly higher in right than in left lobe. Follicles more angular and colloid thinner.	
17. (66).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*20 days.	Epithelium abnormally high in places. Many follicles filled with cells. Right lobe obtained post mortem.	Dog died of pneumonia on 20th day after operation.
18. (50).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*20 days.	Normal. Some follicles filled with cells. Right lobe obtained post mortem.	No convulsions nor tremors. Autopsy negative.
19. (75).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*20 days.	Follicles filled with cells. Epithelium in one of three sections higher than normal. Right lobe obtained post mortem.	No convulsions nor tremors. Gums normal. Autopsy negative.
20. (112).	Extirp. l. lobe. Open treatment of wound.	22 days.	Normal.	
21. (35).	Manipulation enucleation. Vessels uninjured. Closed wound. Plaster of Paris dressing. Healed per primam.	*24 days.	Cuboidal epithelium. Many follicles filled with these high cells. Colloid absent. No involutions. Right lobe obtained post mortem.	Pneumonia of right lung.

22. (68).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*25 days.	Epithelium higher than in left lobe. Colloid disappeared. Follicles slightly angular. No involutions. Right lobe obtained post mortem.	Gangrene of gums and sides of tongue. Gangrenous ulcer on dorsum of tongue. Small pneumonic area in left lung.
23. (93).	Extirp. inf. half l. lobe. Open treatment of wound.	26 days.	Early hypertrophy.	
24. (72).	Extirp. l. lobe and substitution transplantation. Closed wound. Plaster of Paris dressing. Healed per primam.	*39 days.	No hypertrophy. Most follicles filled with cells. Right lobe obtained post mortem.	No convulsions nor tremors. Extensive scorbutic gingivitis. Lungs normal.
25. (92).	Extirp. inf. half l. lobe. Open treatment of wound.	42 days.	Inferior half right lobe very early stage of hypertrophy. High epithelium. Colloid present.	Follicles filled with cells in sup. ½ of right lobe (removed at autopsy).
26. (109).	Complete extirp. l. lobe. Open treatment of wound.	45 days.	Early hypertrophy. High epithelium. Thin colloid. Angular follicles. No involutions.	
27. (87).	Extirp. inf. half l. lobe. Open treatment of wound.	49 days.	Hypertrophy. Very high epithelium. No colloid. Angular follicles and involutions.	
28. (81).	Extirp. inf. half l. lobe. Open treatment of wound.	50 days.	Advanced hypertrophy.	
29. (86).	Extirp. inf. half l. lobe. Open treatment of wound.	50 days.	Advanced hypertrophy.	
30. (105).	Ligation of everything at upper poles except arteries. Open treatment of wound.	51 days.	Normal.	No unnecessary manipulations of the lobes during the operation.
31. (83).	Extirp. inf. half l. lobe. Open treatment of wound.	53 days.	Hypertrophy. Involutions unusually numerous.	
32. (77).	Extirp. l. lobe and substitution transplantation. Closed wound. Plaster of Paris dressing. Healed per primam.	56 days.	Advanced hypertrophy. Dog perfectly well when right lobe was removed.	

*Died.

TABLE IV.—CONTINUED

No. of dog	Operation	From first operation to removal of right lobe	Condition of right lobe	
33. (103).	Extracaps. enucleat. both lobes. Principal arts. and veins intact. Open treatment of wound.	*57 days.	Advanced hypertrophy. Weight of left lobe 3 grms. Weight of right lobe 1 grm.	Interesting case because symptoms of total extirpation appeared and disappeared, and because the dog died with symptoms of thyroid privation, notwithstanding the tremendous and hypertrophied lobes.
34. (67).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	61 days.	Almost normal. Epithelium silghtly higher than normal.	Dog much emaciated when right lobe was removed. Has not been well since first operation.
35. (96).	Extirp. sup. ½ left lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	63 days.	Advanced hypertrophy.	
36. (69).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Superficial suppuration of wound.	64 days.	Advanced hypertrophy.	Scorbutic gums and loss of hair after first operation. Entire recovery before second operation. Two small gl. parathyroid. found outside of capsule of right lobe. Precisely same structure as right lobe.
37. (56).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	*65 days.	Early hypertrophy. Right lobe obtained post mortem.	Scorbutic gums. Central corneal ulcer of left eye. Extensive loss of hair. Had tremors of tongue after first operation, which disappeared in a few days.
38. (43).	Extirp. l. lobe and substitution transplantation. Plaster of Paris dressing. Healed per primam.	67 days.	Hypertrophy.	Dog lively and well after first operation. No loss of hair nor inflammation of eyes nor gums.
39. (70).	Complete isolation right lobe. Closed wound. Healed per primam.	68 days.	Left lobe hypertrophied. Exceptional case in that right lobe was first operated upon.	Dog had scorbutic gingivitis and lost his hair after first operation, but was perfectly well when left lobe was removed.
40. (55).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Healed per primam.	70 days.	Advanced hypertrophy.	Dog well at second operation. There are four intracapsular glandulae parathyroideae which have precisely the same structure as the hypertrophied right lobe.

41. (2).	Extirp. l. lobe. Closed wound. Plaster of Paris dressing. Superficial suppuration at upper angle of wound.	71 days.	Advanced hypertrophy. Weight 2½ grams.	Dog was lively and well until right lobe was removed.
42. (91).	Extirp. inf. ⅔ l. lobe. Open treatment of wound.	71 days.	Advanced hypertrophy.	
43. (48).	Complete isolation l. lobe. Closed wound. Plaster of Paris dressing. Wound suppurated.	75 days.	Hypertrophy. Festoon stage. Weight 2½ grams.	Dog was apparently well, but quite thin when right lobe was removed.
44. (104).	Extracaps. enucleation both lobes. Arts. and veins intact. Open treatment of wound.	82 days.	Hypertrophy. Festoon stage.	Full history given in the text.
45. (84).	Extirp. inf. ½ l. lobe. Open treatment of wound.	82 days.	Advanced hypertrophy.	
46. (82).	Extirp. inf. $\frac{2}{5}$ l. lobe. Open treatment of wound.	85 days.	Advanced hypertrophy.	
47. (90).	Extirp. inf. half l. lobe. Open treatment of wound.	95 days.	Advanced hypertrophy.	
48. (94).	Extirp. inf. half l. lobe. Open treatment of wound.	99 days.	Advanced hypertrophy.	
49. (85).	Extirp. inf. ½ l. lobe. Open treatment of wound.	104 days.	Advanced hypertrophy.	
50. (126).	Ligation of l. lobe just above inf. tip. Open treatment of wound.	132 days.	Advanced hypertrophy.	
51. (127).	Ligation l. lobe just above inf. tip. Open treatment of wound. 2nd operation. Excised left lobe and inf. ⅓ right lobe. 3rd operation. Excised middle ⅓ of right lobe.	132 days. 203 days after 2nd operation and 335 days after 1st operation.	Normal. Left lobe and inf. ⅓ of right lobe. Early hypertrophy (middle ⅓ of right lobe). Colloid present. Epithelium higher than left lobe. Some festooning.	

* Died

PRESERVATION OF THE PARATHYROIDS DURING THYROIDECTOMY[1]

The cause of tetany at the hands of well-versed operators is, I believe, less often removal of the parathyroids than interference with their circulation; and I am inclined to feel that the procedure of stripping the posterior capsule so beautifully executed by Dr. C. H. Mayo does not guarantee the safety of the parathyroid bodies. To assist in determining this point the removal of one lobe furnishes no evidence whatever. It is only from the results of operations on both lobes that we can base an opinion. But who, in order to decide the question, will take the risk of causing tetany? I fear to do an operation, even on one side, except in quite ill cases, which does not contemplate the *leaving of a slice of the thyroid gland in the region of the ultimate distribution of the inferior thyroid artery.* I avoid also ligation of the trunk of the superior thyroid artery, for fear of injuring the tiny branch to the superior parathyroid, and hence usually *slice through the gland a little below the superior pole.*[2]

A parathyroid situated from 1 to 3 cm. below the inferior pole is in particular danger from the operation, for it is likely to receive its blood supply from a branch of one of the ultimate divisions of the inferior thyroid artery just before it enters the thyroid gland. Ligation of this division of the inferior thyroid artery even at the termination of its visible portion quite surely cuts off the barely visible branch to this parathyroid. There is often not room, even if the tiny parathyroid branch were discovered, for the application of the artery forceps distal to the point of origin of the parathyroid artery.

My knowledge of these facts is obtained from the beautifully injected specimens and drawings of Mr. H. M. Evans, who has taken great interest in the study of the vascular supply of the parathyroid glands, particularly with reference to the feasibility of saving the parathyroids by the operation of stripping the capsule of the thyroid gland.

One of three plans may, so far as I am able to foresee, be followed by the surgeon who desires to save the parathyroids: (1) Slice through the thyroid

[1] Remarks in discussion of Dr. C. H. Mayo's paper, "Treatment of the posterior capsule of the gland in thyroidectomy, based on 375 operations for goitre." American Surgical Association, Washington, D. C., May 7-9, 1907.

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[2] The first mention of this procedure.—W. S. H.

gland in such a manner as to leave *in situ* and with intact blood supply the area in which the parathyroids usually lie. This does not absolutely guarantee the life of the parathyroids. (2) At the preliminary operation ligate the superior and inferior thyroid arteries with the expectation that the parathyroids will receive a peripheral (extrinsic) blood supply, and a week or two later perform the subcapsular operation. (3) Search for the parathyroids before ligating any vessels of the thyroid gland; demonstrate the precise origin of each parathyroid artery; continue in such manner as not to imperil the circulation of the parathyroid. For this procedure much practice on the cadaver is essential.

SURGICAL TETANY AND THE PARATHYROIDS[1]

The result of the surgical treatment of exophthalmic goitre in The Johns Hopkins Clinic has been surprisingly successful. Of some ninety cases of this affection operated on by Dr. Halsted during the past fifteen years, only two patients have died, and both of these in the current year. Of the two fatal cases, one weighed only 60 pounds at the time of the operation, and was losing at the rate of three pounds a week while under observation. The other patient died very suddenly four days after operation, during apparent convalescence.

Speaking of the danger of surgical tetany, which, until the epoch-making discovery of Gley in 1891, was incomprehensible, Dr. Halsted said that it seems hardly credible that the loss of bodies so tiny as the parathyroids should be followed by results so disastrous. With our knowledge of the function of the parathyroid glandules comes not only the recognition of the necessity for their preservation, but of the more frequent occasion for operations which imperil the vitality of these bodies. Seven cases of operative tetany within the past two years in the practice of a certain great surgeon probably exceed in number all that have occurred in his practice during the quarter century preceding. The ligation of two thyroid arteries has in several instances been followed by tetany. From simultaneous ligation of the four thyroid arteries in exophthalmic goitre the danger of tetany is so great as to contraindicate this procedure. In performing unilateral thyroid lobectomy, Dr. Halsted maintained that one should not sacrifice either of the parathyroid glandules of the operated side, for tetany may follow the excision of one lobe, and indication for the removal of the other lobe may subsequently arise. The cases of tetany occurring in the practice of experienced operators are, he thought, less often due to the actual removal of the parathyroids than to interference with their circulation. For the preservation of these little glands knowledge of their blood supply as well as of their location is essential. Their situation is, in general, along the posterior border of the thyroid lobe, commonly in the course of an anastomotic channel connecting the superior and inferior arteries. They may be found at

[1] Remarks in discussion of papers by Drs. S. P. Beebe, Wm. G. MacCallum, Lewellys F. Barker, R. B. Preble and A. Kocher in the symposium on goitre at the Joint Session of Sections on Practice of Medicine, Surgery, and Anatomy, and Pathology and Physiology of American Medical Association, at the 58th Annual Session, Atlantic City, N. J., June, 1907.

J. Am. M. Ass., Chicago, 1907, xlix, 1243-1244.

any point from the top to the bottom of the thyroid gland, along its posterior border and posterointernal surface, and at least one is quite constantly found near the entrance into the thyroid gland of one of the branches of the inferior thyroid artery.

H. M. Evans has demonstrated that each parathyroid glandule has its own little artery, given off usually from a branch of the inferior thyroid or from the channel connecting the superior and inferior thyroid arteries; and directly or indirectly always from the last-named arteries. Somewhere in the middle two-fifths of the posterior border of the thyroid gland these parathyroid glandules are ordinarily found, the superior one being rarely as high as the superior pole, and the inferior one frequently below the inferior pole of the thyroid gland.

Not infrequently it is very difficult indeed to avoid cutting off the blood supply of these glandules in the course of operation, for the parathyroid artery may be given off from its parent stem just as the latter is entering the thyroid gland. In such cases there is not room for the point of even the finest artery forceps on the parent stem distal to the point of origin of the parathyroid artery. Twice Dr. Halsted found it quite impossible, for the reason just given, to save a parathyroid glandule; and on several occasions, in the course of operation, he has transplanted into the thyroid gland a parathyroid body whose circulation was threatened or cut off. In dogs he has many times transplanted parathyroid glandules into thyroid gland and spleen—occasionally as many as seven or eight of these little epithelial bodies into one spleen. After eight months of experimentation he has been unable to obtain functional proof of the success of a transplantation, although six weeks after the transplantation into the thyroid gland there was anatomic evidence of the success of the experiment. Hence he feels that at present one cannot rely on transplantation of the parathyroid glandules. The main reliance in case of tetany is the injection, hypodermically, of the proteids of these bodies as prepared by Dr. S. P. Beebe.

Dr. Halsted stated that the procedure in the course of thyroid lobectomy which seems to him best to guarantee the safety of the parathyroid glands is ligation of the branches of the thyroid arteries as far peripherally as possible, beyond the point of origin of the parathyroid arteries. The slicing of the thyroid lobe distal to the parathyroid-bearing area, he said, is not to be countenanced in severe cases. This procedure, which may be resorted to in many cases of colloid and nonhypertrophic goitre, is in the exophthalmic form reserved by Dr. Halsted for operations on the second lobe, and for the special occasions when the blood supply of the parathyroid is such that ligation of the little radicle beyond the origin of the parathyroid artery is impracticable.

HYPOPARATHYREOSIS, STATUS PARATHYREOPRIVUS, AND TRANSPLANTATION OF THE PARATHYROID GLANDS[1]

We have no term except tetany to express the condition resulting from an insufficience of parathyroid tissue or parathyroid secretion. Probably the explanation of this is the fact that hitherto no instance of what might be termed hypoparathyreosis of a degree less than the tetanic one has been described. I would, therefore, propose *Status Parathyreoprivus* and *Hypoparathyreosis* as appellations to designate the condition of the individual suffering from partial or complete loss of parathyroid tissue.

We have had the exceptional opportunity to observe for about fourteen months symptoms due to parathyroid extirpation or destruction and ameliorated at times by the administration of the parathyroids of beeves. Tetany has not been permitted to develop nor the manifestations of deprivation of parathyroid secretion to mature sufficiently for the production of the Trousseau or the Chvostek phenomena. We might define the condition of this patient as subtetanic hypoparathyreosis.

The first to describe in recognizable form the affection which we term tetany was a German named Steinheim, who in 1830 termed it *Hitziger Gelenkrheumatismus,* believing that the disease was closely allied to acute multiple articular rheumatism. The following year there appeared a publication by Dance entitled *Observation sur une espèce de tetanos intermittent.* This author recognized the essential feature of the affection, the intermittent character of the attacks of spasm.

Within the next few years numerous articles by French authors were published on contractures of the extremities, which, however, shed very little light on the subject. The especial contributions to the knowledge of this disease rendered by Trousseau, Erb, Chvostek, and other more recent writers are probably well known. In 1845, Trousseau, having observed the attacks in a nursing woman, termed the affection "contracture rhumatismale des nourrices." But in 1852 the disease was carefully studied by Lucien Corvisart, who proposed for it the name tetany, an appellation which it has since maintained.

Tetany has been observed as an endemic, an epidemic, and a so-called idiopathic form in apprentices of various forms of hand labor; in infections, including malaria; in intoxications; in gastrointestinal disturbances; after

[1] Am. J. M. Sc., Phila. and N. Y., 1907, n. s., cxxxiv, 1-12. (Reprinted.)

exposure, particularly in children; during teething; in Bright's disease; in pregnant, confined, and nursing women; as a symptom in certain affections of the nervous system; after operations for goitre.

In 52 extirpations of the thyroid gland in Billroth's clinic, tetany occurred 12 times, or in 23 per cent of the cases; death occurred in nine of these. Von Eiselsberg in 1890 stated that 30 cases of tetany due to thyroid extirpation had been observed. Of these, seven are said to have recovered, three to have suffered chronically from the affection, and 13 to have died. The result in the remaining seven cases was unknown. Of the 12 carefully observed cases of Billroth there was, probably, one recovery; two cases became chronic. A number of chronic cases of operative tetany have been observed, some of them for many years, by various surgeons; these patients are reported as having periodic attacks of tetany at irregular intervals, and as being quite well between these tetanic manifestations. Total extirpation of the thyroid yielded a much greater percentage of tetany in the hands of some operators than of others; and so before anything was known of the parathyroid glands total extirpations were rarely undertaken except for malignant disease; in several of these fatal tetany occurred.

The study of our case of aborted operative tetany has been greatly facilitated by the cooperation of the unusually intelligent patient, a cultivated woman who, prior to the operation, was in excellent health except for the distress of a large and rapidly growing goitre. On May 5, 1904, I excised, for this patient, at The Johns Hopkins Hospital, the left lobe of the thyroid, endeavoring to leave *in situ* both of the parathyroids of this side if possible. A careful examination of the removed lobe, by Dr. MacCallum as well as by myself, did not reveal a parathyroid gland. The patient returned March 26, 1906, to be relieved of the asphyxia and apprehension caused by the remaining lobe, which from the usual change in position following the unilateral operation, and from a very considerable increase in size, resembled, on superficial examination, a bilateral and rather symmetrical, large goitre. The patient having said to me before operation, "Remove it all if you can, for I would rather take thyroid extract the remainder of my life than have the goitre return," and as the goitre had grown rapidly since the previous operation I determined to remove as much of the thyroid proper as could, in our opinion, safely be done. Although the goitrous lobe was carved in a way which I thought would not endanger the lower parathyroid gland, the knife actually grazed the edge of this body, which I detected immediately on the excised portion of the right lobe, in quite a normal relation to a branch of the inferior thyroid artery. It happened that on the preceding day I had performed the same operation, and in much the same way, for a goitre of the right lobe of the same kind, on a patient whose left lobe

I had removed seven years ago. A stump of the same shape and in the same position was left, but it contained, presumably, the right inferior parathyroid. In both patients the four thyroid arteries had been tied in the course of the two operations on each. We watched the convalescence of the patients carefully; the one first operated upon recovered without incident, but the second was not herself from the outset, although her temperature and pulse were about normal. "This recovery is entirely different from the previous one," she would frequently remark. "I do not understand myself. I have never felt so before." She was unnaturally flushed for two or three days; was restless and slept badly. But she believed herself to be improving until the seventh day, when queer feelings developed, so emphasized at times that she designated them as attacks, although she was uncomfortable and a little apprehensive between the attacks even at this time. It is interesting to note that even in the beginning, when the sympoms were very indefinite and mild, they became concentrated in a way to suggest periodic explosions.

My daily visit to the patient was omitted on the seventh day. On the following day, the eighth since the operation, she had, during the morning, several "attacks," and at my visit, about 2 p. m., I found her quite excited and not a little apprehensive. While attempting to describe her feelings in these attacks or "spells," there developed one, superinduced, it seemed, by the incidental increase in mental activity. It passed through phases precisely as she had described them for the previous attacks. "I feel a numbness in my lips as if the blood had stopped in them; a sort of wave of numbness is passing over my face"; and a few seconds later, "Now it is going into my arms; now it is passing off. Oh, it is dreadful! I would really rather die than have even a few more attacks like these. They are indescribably awful." On the disappearance of the "numbness" or lifeless feeling of the lips, for example, it seemed to the patient as if the blood which had suddenly been blocked was rapidly let into the affected parts again. We were unable to see variations in the appearance of the lips during the attack. The patient insisted that she could not have closed her eyelid without a finger if her life had depended upon it. This suggests hysteria, but those who saw her in this attack doubted not the existence of a very serious condition. She looked ill, quite alarmingly so. Dr. MacCallum, appealed to in haste, placed at our disposal his entire collection of the dried parathyroids of beeves. I was so concerned about the patient and so confident as to the nature of the symptoms that it did not occur to me to make the Chvostek and Trousseau tests until several parathyroids had been given, and even then I feared for several days to make prolonged pressure on the femoral artery, or to test the electrical reactions. The effect of parathyroid exhibi-

tion was almost instantaneous and most marvellous. Large doses were given at first, six dried glands every three hours.

Hoping to stimulate hypertrophy of any parathyroid tissue which might still be in the body we reduced the number, in the course of a few days, gradually to one gland three times daily.

The patient could not, for several weeks, bear further reduction in the dose of parathyroids, although she was perfectly willing and almost eager to attempt it, notwithstanding her feeble and strange, neurasthenic-like condition.

Tapping the facial nerve, repeatedly tried, has not once elicited a response. Nor has pressure of the femoral artery, exercised for periods of four and five minutes, been followed by contractions.

Naturally of a most cheerful and optimistic disposition, she made a brave fight during brief frequent, dispiriting periods, of which the duration was rarely more than a few hours—often only one, though occasionally twelve. Attempts to test electrical reactions distressed her so acutely that they were given up. Convergence tests of the internal recti muscles unnerved her; she involuntarily frowned when the finger approached the nose, as if the effort to follow it were actually painful. A slight, hard oedema of the legs between the knee and ankle and a cold skin persisted for weeks. For a brief period there was albumin in the urine. Sudden changes of weather, particularly to cold, affected her badly. On showery days she would say, "I feel precisely as if I were taking electricity." She expressed at the outset great aversion to sweets and a desire for acids, but when parathyroids had been given for perhaps two days she nibbled bonbons with relish.

For the eight days after operation and preceding the administration of the beeves' parathyroids there was a rapid loss of weight. After the administration of parathyroids was instituted there was for several months a slow gain in weight.

Our patient remained in the hospital for twelve (?) weeks after the operation, taking the fresh parathyroids of beeves, at times in large amounts, during the entire period, except for the first thirty-six hours after the development of the privation symptoms and on the few occasions when the dried glands were substituted for the fresh, either for the sake of comparison or because the supply of fresh parathyroids had been unexpectedly interrupted. Their exhibition was by mouth only, as prolonged hypodermic administration of the crushed glands could not, it seemed to us, be endured, owing to the physical properties of the emulsion, the bulkiness of the dose, and the annoyance and danger from the hardly avoidable infection. The patient promptly discovered, as did we, that the dried glands, a nauseous dose, seemed less effective than the fresh.

In preparation for ingestion the fresh glands were carefully freed from fat, chopped very fine, and served on thin, crisp water-crackers. The dried, powdered glands were usually given in gelatin capsules. During the summer and autumn of 1906 the patient, at home in the South, took the dried glands. Their discontinuance in November, 1906, for about three months was without effect, appreciable either by the patient or her family; and after resumption of the parathyroid feeding for about one month without benefit the ingestion of the dried preparation became so revolting that its exhibition was discontinued.

March, 1907.—From correspondence I judge that the patient has in some ways slowly improved. There has been a little gain in appetite and in strength, and, as I have said, a considerable gain in weight. But she is an invalid. Her nervous system is quite wrecked. Conversation, even of a light and bright nature, unnerves her; so does a walk of one hundred or fifty or a less number of yards, or even sitting up in a chair for an hour or two. Shall we term this condition a cachexia parathyreopriva? And may not, in some cases, the cachexia thyreopriva, so called, have been compounded of thyroid and parathyroid privation? Cachexia thyreopriva must be studied from a new point of view. Our patient writes that during the past three or four months pain in her knees, elbows, and shoulders is quite constant and at times distressing. There is, perhaps, no pain except that induced by motion, although this may persist for many minutes, particularly after some hasty, uncalculated movement. Exercise of the knees elicits crackling noises which at times may be heard by those at the bedside. The nature of this affection of the joints, or joints and tendons, has not been determined.

I have it in mind to make hypodermic injections of the parathyroid-nucleoproteid which Dr. Beebe, of New York, is now, he kindly tells me, experimenting with, and hope that the experiments in transplantation of the parathyroids in animals which I have been conducting since January may give results to encourage the therapeutic use of this measure in the case of our patient for whose pitiable plight I am responsible.[2]

Picture the operator's state of mind if, instead of one, a number of cases of tetany or hypoparathyreosis were placed to his—shall I say, credit?

[2] For two months, at intervals, we have been giving hypodermically parathyroid nucleoproteid, most kindly contributed by Dr. Beebe, and with definite though transient benefit. The patient promptly noted a difference in the effectiveness of the several preparations. The tubes labelled "inert" by Dr. Beebe were ineffective, or nearly so; the others produced definite amelioration of the symptoms. During treatment the pains in the joints and the twitchings disappeared promptly and completely, the feeling of great depression was dissipated, and the patient could accomplish without fatigue what before the treatment and in the intervals was impossible.

A certain measure of consolation is found in the knowledge that the deplorable result was brought about in the effort, fortunately successful, to cure a hardly endurable condition, one which menaced life. The patient charitably insists that her present state is preferable to the wholly intolerable one from which the operation freed her.

The Transplantation of Parathyroid Glands

I had been seriously deliberating as to the advisability of attempting subperitonaeal transplantation of the parathyroids for this patient when there appeared the impressive report of Payr[8] on the successful transplantation of portions of the thyroid gland into the spleen, both in animals and the human being. From Payr's concluding summary I abstract the following: The spleen possesses, thanks to its altogether peculiar and rich blood supply, unusually excellent conditions for the transplantation of all kinds of tissue. The circulation is rapidly restored, a relatively small proportion of the transplanted part is sacrificed to central necrosis, and the processes of regeneration are more active and more extensive than in any of the methods of transplantation heretofore employed. The chief consideration against the transplantation into the spleen is the danger of haemorrhage. But by numerous experiments in animals a technique has been developed which has effectually overcome this danger. Chief among the technical features are the use of the transplanted organ as a wedge in the splenic wound and of the omentum as a support for the stitches and a covering for the line of incision in the spleen. It has been possible by this method of splenic transplantation to keep alive for a period as long as three hundred days animals which otherwise would have perished with symptoms of insufficience of the thyroid gland. Into the spleen of a child, six years old, totally imbecile and with severe infantile myxoedema (treated almost without result for a period of three and a half years with thyroid feeding), a large piece of the thyroid gland of the perfectly healthy mother was transplanted. The result, to the present time, somatically as well as intellectually, is highly satisfactory.

Payr's work stimulated me to attempt splenic transplantations of the parathyroids on dogs with the hope that if successful I might do the same thing for my patient. As the result of a very considerable experience in thyroid transplantation gained by me in 1888 the spleen seemed an ideal organ for the purpose. The technique of the thyroid transplantation as

[8] Transplantation der Schilddrüsengewebe in die Milz; experimentelle und klinische Beiträge, Langenbeck's Archiv, Band lxxx, p. 730; also Verhandlungen der Deutsche Gesellschaft für Chirurgie, 35te Congress, i, 155, and ii, 503.

developed by Payr was very simple. The block of thyroid tissue used as a wedge assisted in the arrest of haemorrhage from the spleen. But the tiny shavings of disks of parathyroid tissue could not play such a rôle, and the bleeding from the little holes made bluntly in the spleen altogether prevented the introduction of the parathyroid films, promptly floating them entangled in a clot to the surface. After a few unsuccessful trials the following procedure was devised: A split thread of china-bead silk is armed with two very fine needles, No. 16. The properly prepared parathyroid, or preferably the little supporting rim of thyroid gland, is perforated with one of the needles and the minute gland slipped an inch or two on to the thread, great care being exercised to avoid crushing it. A little hole is made in the spleen with a fine-pointed artery forceps, the blades of which are opened wide enough to admit the parathyroid between them. Both needles, first one and then the other, introduced between the blades of the artery forceps down to the apex or bottom of the hole made in the spleen, transfix the spleen and emerge on the opposite side a few millimetres apart. The thread ends are pulled upon until the transplanted piece is carried to the bottom of the hole prepared for it. The spleen is then darned very gently with a mattress stitch or two of this split china-bead silk on the fine needles, carried from quite a distance on both sides across the base and middle of the hole, and finally one of the threads which have been held taut is divided close to the under surface of the spleen and withdrawn. This method serves infallibly to fix these tiny films in the desired position. The bleeding from extensive tears, crushings, or cuts may be controlled by this method of darning.

As the threading of these very fine needles is difficult, the double arming of the silk may be avoided by a slight modification of the procedure, which we have used of late. A single needle, threaded, is passed from the under surface of the spleen upward into the apex of the transplantation hole, made in the manner described; then, impaling a parathyroid, it is carried back into the hole from which it has just emerged and thence through to the under surface of the spleen a few millimetres from its point of entrance.

In the dog the inferior parathyroids in preference to the superior have been selected by me for transplantation, because, being partly embedded in the thyroid gland and thus splinted by it, they may be shaved with a sharp cataract knife or fine scalpel, on the exposed surface. Under and about the parathyroid a little thyroid tissue should be left. Thus framed in thyroid tissue the tiny parathyroid disk can conveniently be manipulated and speared by the needle without injury.

The thyroid glands, particularly when hypertrophied, as in Graves' disease, should serve admirably for transplantation of the parathyroids. On

several occasions, operating for exophthalmic goitre, I have transplanted back into the other lobe or into the isthmus a parathyroid whose nutrition was cut off or greatly imperiled. Once the parathyroid so transplanted had been unintentionally excised. In a case of carcinoma of the stomach with gastric tetany and in the course of an operation for gastroenterostomy, I attempted transplantation into the spleen of fresh parathyroids, obtained by Dr. MacCallum and Dr. Sowers from a body dead only about an hour. Unfortunately at the instrument table a drop or two of a solution of carbolic acid accidentally came in contact with these parathyroids, and hence I desisted from the attempt to transplant them, although the spleen was in my hand and already prepared for the transplantation.

I had the pleasure of demonstrating a few months ago at my clinic, and before the Interurban Clinical Club, which complimented me by attending it, microscopic sections showing the morphologically successful transplantation in dogs of parathyroids into the thyroid gland, and I hope to be able to report soon the result of functional tests.

We have transplanted parathyroids into the thyroid gland and spleen in 17 dogs. On each of two occasions as many as eight dogs were used in the search for a large number of parathyroids suitable for splenic transplantation. In the spleen of each of three dogs as many as seven parathyroids were at one time transplanted.[4]

Tetany, inexplicable so recently as eighteen years ago, has been made comprehensible by one of the greatest and most impressive physiological discoveries of modern times. Four or more tiny bodies, so small as to have attracted no serious attention until, in 1880, Sandström classified them, quickly assumed upon the epoch-making discovery of Gley, in 1891, an importance hardly to be overestimated. Their situation, so deep in the neck, so carefully tucked away under the jaw and behind the thyroid lobes; their nutrition, each gland with a blood supply independent of the other

[4] *June 8th.*—I have recently made the physiological test in three dogs, into each of whose spleens from six to eight parathyroids had been transplanted, by excising in each both thyroid lobes and all the parathyroid glands. The three dogs died promptly of tetany: one in thirty-six hours, one in two days, and one in six days. On examination of the spleens it was found that all of the parathyroids had been absorbed except a small portion of two or three which had been badly transplanted and lay almost on the surface of the spleen, with a portion exposed. Are these findings to be explained perhaps by the presence of the splenic toxin? A few days ago I removed from a dog two thyroid lobes into which several parathyroids had been transplanted about four months before. To the unaided eye there remained at the site of the transplanted parathyroids no trace of these bodies except little pigmented areas and perhaps an abnormal juiciness.

It is my intention to publish later a detailed report of the experiments, which are being continued.

and in no danger of being cut off except by the surgeon's knife; and their number, generally four or more, might be viewed to indicate their preciousness. Their blood supply is a rich one and may well be subject on occasion to great and sudden increase, as in the active thyroid hypertrophies and hyperaemias. Their vascular supply is so intimately related to and dependent upon that of the thyroid that they could hardly escape, it would seem, promptly and altogether, the effect of a sudden turgescence of the thyroid lobes, although controlled undoubtedly by regulating vital processes. The possibility of an interdependence, to a certain degree, of function between the thyroid and parathyroid glands has suggested itself to several investigators.

In this connection the "Note during Proofreading," appended to Dr. Reid Hunt's article on "The Influence of Thyroid Feeding upon Poisoning by Acetonitrile," is very interesting: "Later experiments show that feeding with parathyroids does not decrease the susceptibility of mice to acetonitrile; on the contrary, it causes a distinct increase of the susceptibility to this poison. Whether this increase of susceptibility is greater than that caused by an equivalent amount of proteid has not been definitely determined, but the indications are to this effect."

In Lusena's hands after experimental parathyroidectomy the average duration of life was only half as long as after parathyroidectomy plus thyroidectomy.

In this connection certain experiments on dogs made in 1888, and before we knew that the parathyroids had any function whatever, may be in point; in the light of our present knowledge they furnish interesting material for speculation. In a few instances [5] I ligated all the vessels, veins and arteries

[5] W. S. Halsted, An Experimental Study of the Thyroid Gland of Dogs, with Especial Consideration of Hypertrophy of this Gland, Johns Hopkins Hospital Reports, vol. i, Baltimore, 1896, p. 378.

Partial Isolation of Both Thyroid Lobes.—The large branch of the thyroid artery which goes to the upper pole and the vein from the lower pole are not ligated; otherwise both thyroid lobes are completely isolated.

Example 1.—Dog 104. *April 19, 1889.*—Open wound.

April 28th.—The dog seems perfectly well. The wound is healed.

April 30th.—The dog has tongue tremors and makes the licking movements with the tongue which we have frequently observed in dogs whose thyroids have been extirpated.

May 1st.—The tongue tremors are less pronounced. The licking movements are still vigorous.

May 7th.—The tongue tremors are pronounced. The dog has no general spasms.

May 14th.—The tongue tremors are very faint.

May 28th.—Dog seems perfectly well.

June 24th.—Hair is falling out, particularly over the eyes.

of both lobes, except the superior thyroid artery and the inferior thyroid vein. In these cases the dogs ultimately died, notwithstanding the fact that as a result of the operation the thyroid lobes enlarged and microscopically showed the hypertrophic picture. These cases puzzled me greatly in those days, when tetany was believed to represent acute thyroid privation, for a modified and chronic tetany occurred, notwithstanding the hypertrophy of both thyroid lobes. Dogs so treated lived nearly three months on the average, in contrast to those with thyroid extirpation, which died usually in from two to nineteen days after operation. These are perhaps the first recorded cases of chronic experimental tetany. Both superior parathyroids were probably deprived of their circulation by the ligature of the superior vein plus the handling incident to the ligation, but the inferior or subcapsular glands should have had the benefit of the blood supply which was sufficient, not merely to prevent necrosis of the thyroid lobes but to cause their hypertrophy—hypertrophy confirmed microscopically. Hence there should have survived for each dog, it would seem, the two internal parathyroids as well as the hypertrophied thyroids. If the existence of antagonism between thyroids and parathyroids were established we might assume that the hypertrophied thyroids were imperfectly equilibrated by the two parathyroids, and that if thyroid hypertrophy had not resulted the two inferior or subcapsular parathyroids would have been more than ample for the prevention of tetany. This is the merest speculation and indulged in to call attention to the experiments which are, I believe, unique and might some day be repeated. In such case the interest would concentrate in the condi-

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June 25th.—The dog has escaped.

June 27th.—Returned of his own accord. The hair is very thin all over his body. He scratches himself constantly. The oedema caused by the scratching gives to the skin about the face and head somewhat the appearance of myxoedema.

July 10th.—Has lost most of his hair. He is very anaemic. His blood is used for direct transfusion into dog 109.

Autopsy.—Both thyroid lobes are large and hard and very firmly bound down to the surrounding tissues by adhesions. With the microscope they were found to be hypertrophied. I believe, judging from the next example (dog 103), that this dog would have died ultimately with the symptoms of thyroid extirpation.

EXAMPLE 2.—Dog 103. *April 19, 1889.*—The wound is left open. The dog was profoundly depressed after the operation.

April 27th.—There is conjunctivitis of both eyes. The wound is doing well.

April 28th.—The dog has symptoms which are characteristic of extirpation of both thyroid lobes. He shivers, has tongue tremors, and general tonico-clonic spasms. His gums are inflamed. The membranae nicitantes are conspicuous. He groans with each expiration.

April 30th.—The tongue tremors persist. The general spasms have ceased. The conjunctivitis is more pronounced. There is a very offensive gingivitis. Dog makes

tion of the inferior parathyroids. With no parathyroid tissue remaining the dogs could not have lived, as they did, for months. The open wound and consequent suppuration in our cases may have partially destroyed the parathyroids; and the cicatricial contraction may have been a factor plus the infection.

Of particular interest to the surgeon is that form of tetany caused by operation upon the thyroid gland. When total excision of the thyroid was practised for the cure of ordinary colloid and other goitres surgical tetany was comparatively common; then for nearly twenty-five years little was heard of this form of tetany, but now again it is making its appearance with alarming frequency and especially at the hands of the most experienced operators, those who are convinced of the advisability of removing in Graves' disease as much of the thyroid as can safely be done. The distinguished surgeon who was perhaps the first to warn against total excision of the thyroid gland is now among the first to advise for the cure of exophthalmic goitre an excision, almost total, of this organ. Within perhaps a year this

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peculiar, almost incessant licking movements with his tongue. These peculiar licking movements have been frequently observed by me in dogs whose thyroid glands have been extirpated.

May 1st.—Seems better. He still has tongue tremors.

May 3d.—His hind legs are slightly stiff. The tongue tremors are scarcely perceptible.

May 7th.—The tongue tremors are more distinct. The conjunctivitis has almost subsided.

May 14th.—The tongue tremors are very faint. There is no conjunctivitis.

May 19th.—All the symptoms of extirpation of both thyroid lobes have reappeared.

May 21st.—The dog seems much better. The tongue tremors are very faint. There are no other symptoms. There is a slight subconjunctival injection.

May 23d.—Except for the faint tongue tremors the dog seems fairly well. He eats well, but is very thin.

May 24th.—Has no tongue tremors, but strong clonic spasms of the flexor muscles of all of his legs. The spasms of the temporal and ear muscles are especially pronounced.

May 25th.—Dog has no spasms and is much better.

June 14th.—All the symptoms of double extirpation have reappeared.

June 15th.—a. m.—Dog found dead.

Autopsy.—The left thyroid weighs 3 gms. and is very hard. The right thyroid weighs 1 gm. For the miscroscopic appearance of both lobes see Plate LXXVII, 3. The fatal result in this and the preceding case (104) is to be attributed probably to extensive destruction of the glands by blood extravasation. Otherwise we could not regard the changes which we designate as hypertrophy as very highly compensatory; for, notwithstanding the fact that the glands weighed two or three times as much as normal and showed the most advanced stage of hypertrophy, one dog died with symptoms of total extirpation and the other had the symptoms which I have described (dog 104), and would probably have died of thyroid privation.

operator has produced six or seven cases of tetany; in no instance was the disease fatal, however; although parathyroids have not in any form been given.

That operative tetany has of late so frequently resulted after a quarter century's interval of freedom from this complication of thyroid removal, is due to the fact that the operation for exophthalmic goitre is becoming much more frequent; the proportionate amount of the gland removed in this operation is increasing, and that the loss of parathyroid tissue seems to be less well sustained by patients suffering from Graves' disease than by those afflicted with the hypothyreotic or colloid forms of goitre.

The Operation

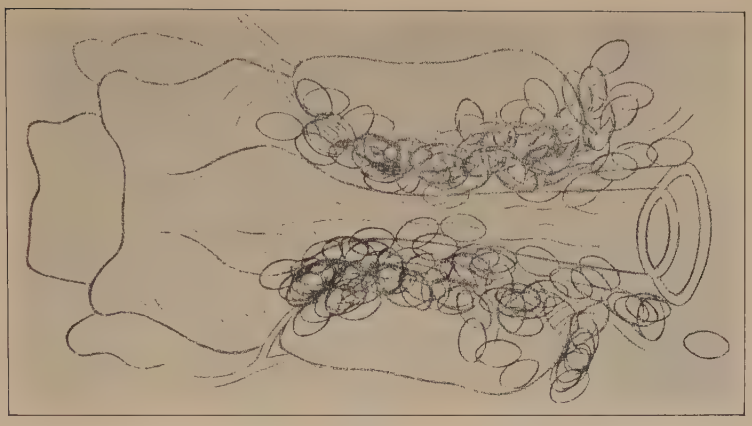
The development of the operation for exophthalmic goitre is an interesting story. Haemorrhage from the large, thin-walled veins was quite terrifying to the surgeon in the early days of the operation, and only a few weeks ago I heard a brilliant operator at work on a serious case exclaim: "This is like hunting for big game; instinctively, I look over my shoulder for a tree when I tackle a difficult exophthalmic goitre." The mortality from the toxaemia of absorption, of blood and of thyroid secretion, was very high. And now the surgery of exophthalmic goitre centres in the problem of removing the greater portion of the thyroid gland without sacrifice of the parathyroids. I know from correspondence with the surgeons abroad who have especially devoted themselves to thyroid surgery that with them this problem is not solved.

I shall take it for granted that the situation of the parathyroid glands is fairly well understood; but a composite chart based on sixty-seven dissections, which were very kindly made for me by Dr. MacCallum, is of interest. (See Plate LXXVIII, 1.) The parathyroid bodies vary greatly in size and not a little in situation. In the diagram, however, they are represented as of equal size, by little ovoid rings. The picture produced by aggregating the parathyroids in this diagrammatic way suggests the epididymis in its relation to the testicle. The composite picture proved something of a surprise, for the study of the situation of these little bodies in Dr. MacCallum's diagrams and of the cases operated upon by myself, had given me the impression that much the densest grouping of parathyroids would, in the composite diagram, be about the insertion of the terminal branches of the inferior thyroid vessels, and that in comparatively few instances would these bodies have to be represented above or even as high as the tip of the superior pole of the thyroid. So skeptical was I of the correctness of the composite diagram that I had a second one made from the same data, but

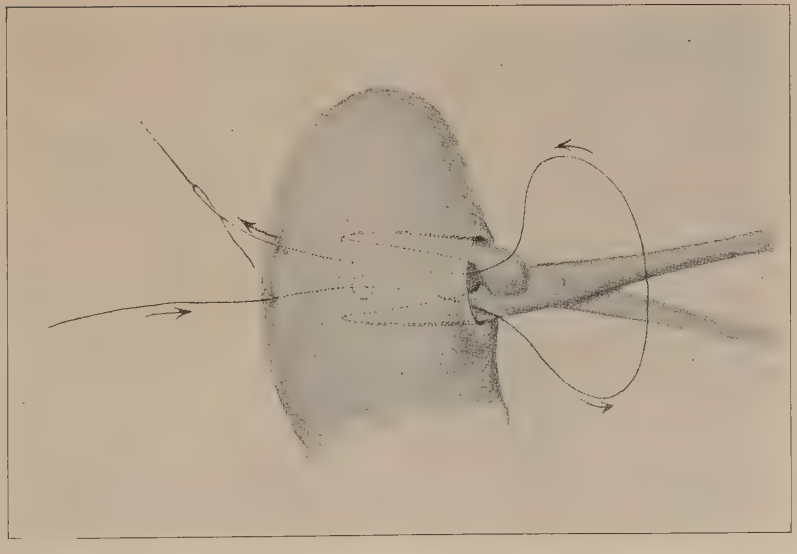
with identical result. One is likely, therefore, to encounter these little bodies, usually two on each side, at any level from the superior to the inferior pole on the posterointernal surface of the gland, but most commonly just internal to the rounded posteroexternal border and quite regularly near the site of the distribution of the terminal branches of the inferior thyroid artery. If the thyroid gland is lobulated in this situation, as is quite commonly the case, a parathyroid may be concealed in a cleft between the lobules. Not infrequently one of these epithelial bodies is located below the inferior pole of the thyroid gland and occasionally behind the sternum.

May the parathyroids be identified with the naked eye in the course of an operation? Yes, and almost infallibly; but perhaps not from any description that I can give. They are little ovoid, spheroid, lenticular, or very flat bodies, exhibiting much variety in form and size and even in color. Externally they often resemble fat very closely in consistence as well as in color. On section, however, the fat about the deep cervical vessels and in the neighborhood of the thyroid gland is usually much whiter than the parathyroid, and the latter has a definite but exceedingly fine, almost microscopic, granular appearance. Differentiation from accessory thyroids or detached or partially detached lobulettes of normal thyroid tissue, is rarely difficult, although careful comparison of the suspected bodies with the tissue of the goitre may be necessary to convince one as to their nature. Partially or wholly detached portions of certain yellowish goitres, or adenomas of the thyroid, may bear a troublesome resemblance to the parathyroids. Lymphatic tissue is quite readily differentiated by the expert. Differentiation may be impossible if the parathyroids have been subjected to trauma, ever so slight.

The cause of tetany at the hands of well-versed operators is, I believe, less often removal of the parathyroids than interference with their circulation; and I am inclined to feel that the procedure of stripping the posterior capsule, so beautifully executed by Dr. C. H. Mayo, does not guarantee the safety of the parathyroid bodies. To assist in determining this point the removal of one lobe furnishes really no evidence whatever. It is only from the results of operations on both lobes that we can base an opinion. But who, in order to decide the question, will take the risk of causing tetany? I fear to do an operation, even on one side, except in very ill patients, which does not guarantee the safety of at least one of the parathyroids on the side operated upon; and hence, for the past year, have practised the leaving of a slice of the thyroid gland in the region of the ultimate distribution of the inferior thyroid artery. I avoid, also, ligation of the trunk of the superior artery, for fear of injuring the tiny branch to the superior parathyroid, and hence usually slice through the gland a little below the superior pole.



1.



2.

Has not the time arrived when the surgeon must learn to recognize at operation not only the parathyroids, but, what is quite as important, the precise nature of their blood supply? Not infrequently the inferior parathyroid is situated one or two or more centimetres below the inferior pole of the thyroid, and in such case its blood supply is greatly endangered by the operation of thyroidectomy, for, as shown by the exquisite injections of Mr. H. M. Evans (work unpublished), this almost invisible branch may be given off from a main division of the inferior thyroid artery just as it is about to enter the thyroid gland. I have today, June 8th, operated upon a case in which this condition existed, and in which stripping of the capsule, although combined with a very thin shaving of the thyroid gland, cut off the blood supply of a parathyroid situated about 2 cm. below the thyroid's inferior pole. If I had known at an earlier stage of the operation of the precise situation of this parathyroid I might have saved it by leaving a broader and thicker slice of thyroid gland.

One of three plans may ultimately be followed by the surgeon who desires to save the parathyroids: 1. Slice through the thyroid gland in such manner as to leave *in situ* and with intact blood supply the area in which the parathyroids usually lie. This procedure is, probably, not applicable to cases which are very ill. 2. At a preliminary operation ligate the superior and inferior thyroid arteries with the expectation that the parathyroids will receive a peripheral (extrinsic) blood supply; a week or two later perform the subcapsular operation. 3. Search for the parathyroids before ligating any vessels of the thyroid gland; demonstrate the precise origin of each parathyroid artery; continue in such manner as not to imperil the circulation of the parathyroid. For this procedure much practice on the cadaver is essential.[6]

[6] I hope to publish, later, with Mr. Evans, the results of his injections of the thyroid and parathyroid vessels. The information already derived from his observations promises to be of considerable practical value.

THE PARATHYROID GLANDULES. THEIR BLOOD SUPPLY, AND THEIR PRESERVATION IN OPERATION UPON THE THYROID GLAND[1]

THE BLOOD SUPPLY OF THE HUMAN PARATHYROID GLANDULES

HERBERT M. EVANS

The vascular injections and studies herein reported were made to determine accurately the exact source and position of the blood supply to the parathyroid glands in man. Another aim, that of knowing more of the angiology of the parathyroid gland itself, was also served, but this subject will be reported separately at a later date. I would here express my indebtedness to Professor Halsted at whose suggestion the problem was undertaken, to Professor Mall in whose laboratory the injections were made, to Professor W. G. MacCallum, Dr. H. E. Helmholz and especially Dr. Marshall Fabyan who have kindly given me many opportunities to secure fresh human material, and to Mr. Broedel whose advice I found invaluable in the execution of the drawings.

Methods.—Recent studies in the finer anatomy and histology of mammals have shown many distinct differences so that it would be no longer justifiable to assume that the findings in the dog, for example, must be identical with those in man. Such a contention is especially strengthened in this particular case by the variation in the size and position of the parathyroid bodies in the animals which have thus far been investigated. With a full realization of this, all of the present work was done on human material. Very different circulatory relations than are here reported may be found in all those animals in which the parathyroid glands are imbedded in the thyroid. In the majority of cases the specimen was secured a few hours after death, the entire neck organs being removed *en masse*. The upper and lower poles of each lateral lobe of the thyroid were then carefully dissected sufficiently to identify the superior and inferior vessels in each case. In most instances, the superior arteries were ligated and the injection mass delivered through the inferior vessels, but in several cases the upper arteries were injected in addition. Though anastomoses generally permitted a partial injection of the opposite side, the two sides were always separately injected. Mercuric sulphide (vermilion) granules in a

[1] By Halsted, W. S., and Evans, H. M.
Ann. Surg., Phila., 1907, xlvi, 489-506. (Reprinted.)

20 per cent gelatin solution were most often used as an injection mass and gave a splendid arterial injection which when long-continued could be made to invade the capillary bed. In several cases, the veins were filled with ultramarine blue and in still others the arteries were injected with India ink, which enters the capillaries with great facility. The entire specimen was immediately cooled in running water and a preliminary dissection made to locate the parathyroid glands. This seemed wise inasmuch as the detection of these glandules was easier in fresh material, in which the natural brownish color was retained, than in specimens in which they were blanched by the preserving fluid. A simple sketch of the position of the parathyroids was then made to be used in identifying them in the final dissection. The specimen was placed in a 10 per cent formalin solution for 24 hours, after which the tissues were sufficiently preserved to permit a careful dissection to be made. Such dissections were accurately charted. Generally the parathyroid glands were ultimately removed, dehydrated in alcohols, and cleared in creosote for further study.

Observations.—Few studies of this region based on actual vascular injections have been made. However, D. A. Welsh,[2] whose excellent paper appeared in 1898, used the injection method. It is unfortunate that no figures of the vascular relations accompanied his study.

One of the first facts which appears after a satisfactory injection is that a special tiny parathyroid artery supplies this gland in every case. This artery may arise from one of the glandular, the muscular, or the oesophageal branches of the inferior thyroid artery, but wherever its origin, it can be seen definitely to supply the parathyroid gland and it alone. One may sometimes see one or two smaller arteries accompanying the parathyroid vessel, but they supply the small fat mass which often surrounds the parathyroid or lies on either side of it; my injections have never demonstrated more than one parathyroid vessel proper, and this enters a distinct hilus in the gland. Though practically all previous studies have not shown any real embedding of the human parathyroid in the tissue of the thyroid, the connective tissue envelope which surrounds the latter gland often appears to split to enclose the parathyroid. It was interesting, then, to observe what vascular connections existed between the capsule of the larger and the smaller glands. Complete injections have uniformly shown only the scantiest blood supply to this connective tissue envestment. It usually consists of a few minute vessels, for the most part capillaries. These are seldom seen to be in any relation with the parathyroid glands and never to be con-

[2] Welsh, D. A., Jour. of Anat. and Physiol., 1898.

nected with the vascular system of the latter, which is always from the parathyroid arteries. This fact was more striking when observed in a rather unique case in which I found the parathyroids so deeply set in the surface of the thyroid that their surface was barely level with that of the larger gland. Here also there was a definite independence of the vascular system of the parathyroid from that of its immediate surroundings. It is thus quite unlikely, even if not inconceivable, that the true capsular vessels of the thyroid could nourish the parathyroids and in those cases in which the lower parathyroids lie below the lower pole of the thyroid, it is all the more improbable.

In practically every case studied, the lower parathyroid artery came from a prominent branch of the inferior thyroid artery. Ten entire specimens were found suitable for accurate plotting. This would ordinarily give 20 opportunities for examining the inferior parathyroid artery, but since the gland was not found in one instance, the actual number of observations was 19. In six instances the inferior parathyroid gland was clearly below the lower margin of the thyroid, and the parathyroid artery in these cases coursed as a distinct, usually unbranched, vessel to the hilus of the glandule. The findings of others would indicate that so great a proportion of these cases is probably a unique experience. In such cases, the parathyroid artery has measured between two and three centimetres in length; in all other cases its course is seldom in excess of four or five millimetres.

The upper parathyroid gland invariably has a short artery of supply which may arise from one of the main branches of the inferior thyroid or from an anastomosing ramus joining the superior and inferior thyroid arteries. A very prominent anastomosing channel was found along the posterior margin of the lateral thyroid lobe in eight of 20 instances and in these cases the superior parathyroid artery was a short branch from this channel. Most often, however, the angle at which the parathyroid vessel came off from its parent trunk suggested strongly that its blood stream was usually from the inferior source.

The conditions found thus varied somewhat, but with the constant features just emphasized. The special picture presented will depend to a considerable extent on the position of the parathyroids; and using this as a sort of basis of classification three common types may be specified. Figs. 59 and 60 illustrate two varieties of what may be called the first type. Here the upper parathyroid lies along the posterior border of the lateral lobe of the thyroid somewhat above the mid-point between the upper and lower "poles"; the lower glandule lies near the lower thyroid margin or pole. It is not unlikely that this particular arrangement will be found occurring

most often in a large series of cases. In Fig. 59, the lower parathyroid artery is seen to arise from the prominent lateral branch of the inferior thyroid artery which supplies most of the outer surface of the lateral thyroid lobe. The upper parathyroid artery here arises from the strong anastomosing channel between the upper and lower thyroid vessels which courses along the posterior border of the lateral lobe. In Fig. 60, the lower little artery comes from one of the lateral glandular rami of the inferior thyroid, while the upper one happens to be a branch of the uppermost oesophageal ramus.

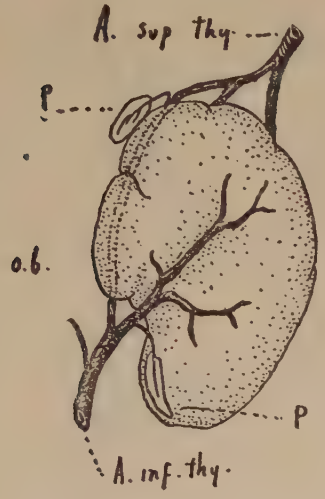


Fig. 59.

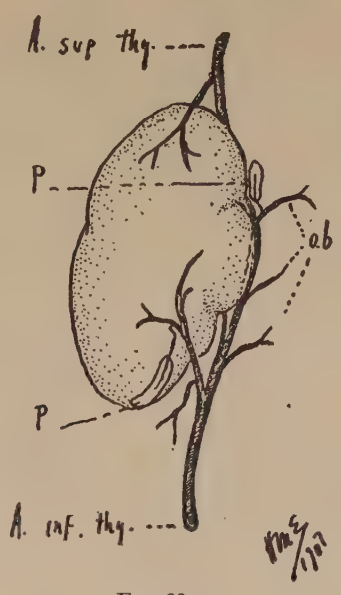


Fig. 60.

Figs. 61 and 62 will illustrate a type but little removed from that just discussed, but one in which the parathyroids are rather symmetrically disposed, the one above, the other below, the mid-point between the thyroid poles. The condition shown in Fig. 62 is interesting since here both parathyroid vessels came from the same large branch of the inferior thyroid, which in this case communicated with the superior thyroid artery.

In the third type, shown in the remaining two figures (63 and 64), is depicted the arrangement seen in those cases in which the lower gland is appreciably below the lower margin of the thyroid. Here it is not unusual to find a relatively long parathyroid artery.

Various other modifications in the exact plan of blood supply were found, but, in general, the figures given illustrate the chief conditions.

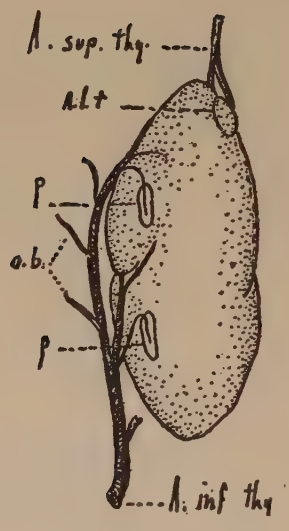


FIG. 61.

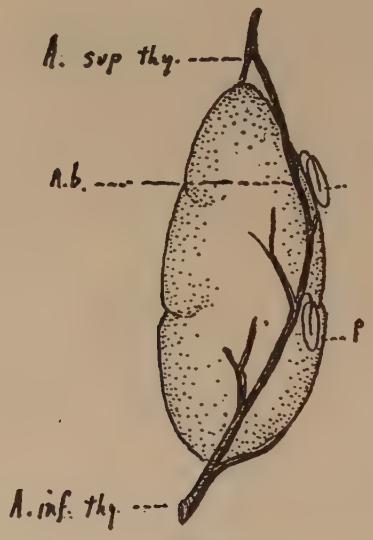


FIG. 62.

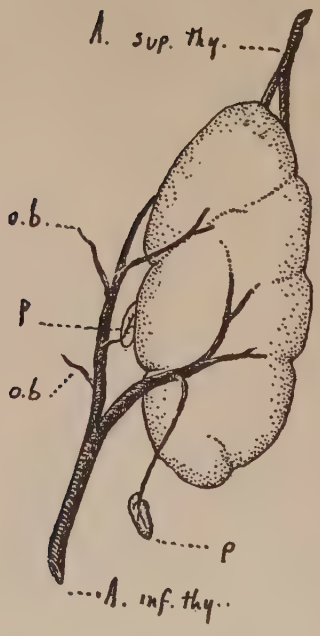


FIG. 63.

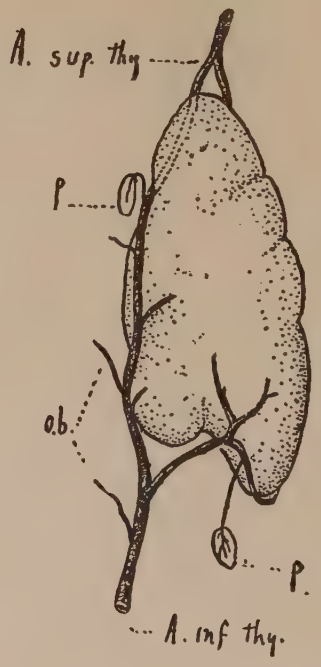


FIG. 64.

It is without the purpose of this communication to follow the behavior of the parathyroid artery after it enters the glandular hilus, but it may be said here that, in general, this vessel pursues a central course, giving off obliquely directed branches which ramify peripherally, eventually giving origin to capillaries. This picture may be seen beautifully in cleared specimens of the glandule and, it may be pointed out, is in contrast to the scheme of circulation which obtains in the case of the thyroid gland.

The chief facts brought forward in the present report may be summarized as follows:

1. The parathyroid glands are always supplied by definite parathyroid arteries which enter them in each case at the hilus.

2. The parathyroid arteries, superior and inferior, usually arise from the inferior thyroid, but frequently they take origin from the anastomosing channel, described above, between the inferior and superior thyroid vessels. Additional types of origin of the parathyroid artery have been described and figured.

3. Few, if indeed any, direct vascular connections normally exist between the parathyroid glands and the connective tissue envelope of the thyroid.

THE PRESERVATION OF THE PARATHYROID GLANDULES IN OPERATION UPON THE THYROID LOBES

WILLIAM S. HALSTED

With our present knowledge, scant as it is, of the function of the parathyroid bodies comes not only the recognition of the necessity for their preservation but more frequent occasion for operations which imperil the vitality of these little life-sustaining organs.

When tetany was believed to be due to thyroid privation the surgeon feared to operate upon both lateral lobes of the thyroid gland, having learned that the death rate from total excision of this organ was very great, and, that tetany, the chief cause of this mortality, might follow the excision of merely one lobe of the thyroid gland or ligation of two or even of one of the four thyroid arteries.

As long ago as 1889 it was discovered that dogs would survive the gradual excision of as much as thirty-one-thirty-seconds and of even a greater proportion of the thyroid gland provided the fraction remaining was the superior pole of either lobe. That tetany did not result was due to the fact, not surmised until the appearance of Gley's superb contributions in 1891, that the superior parathyroid body, situated in the dog very near to and usually a little above the superior pole of the thyroid lobe had escaped destruction by this method of piecemeal excision, from below upwards, of the thyroid

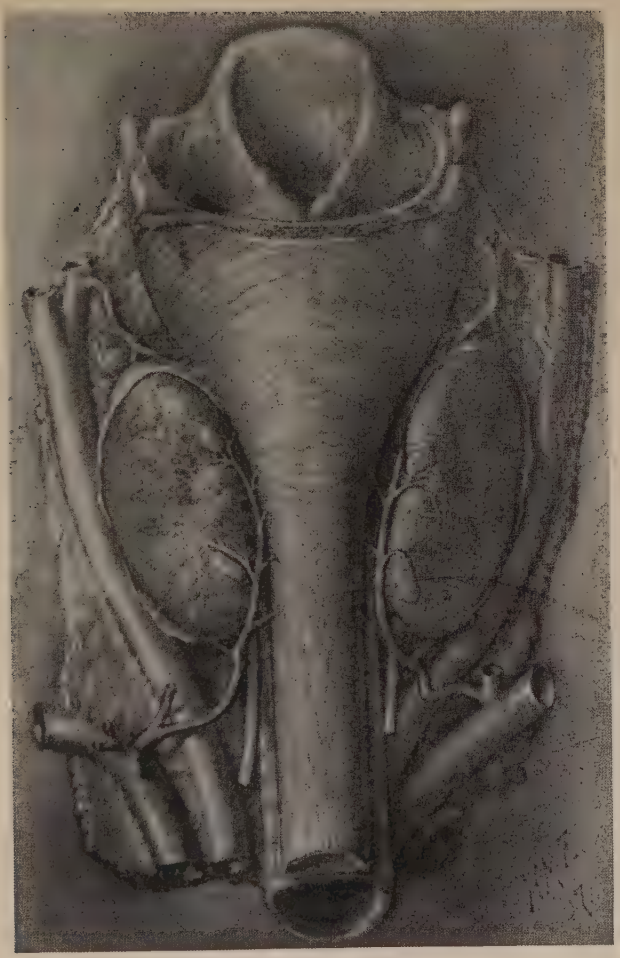
gland. In man, however, with gradual, piecemeal amputation from below upwards of the thyroid lobes destruction of all of the four parathyroid glandules would, as a rule, already be accomplished with the removal of the lower two-thirds, approximately, of each lateral lobe: *vid.* Figs. 60, 61 and Plate LXXIX. But even before it was ascertained that the parathyroid bodies had any function whatever a long series of happy accidents demonstrated that total excision of the thyroid gland might, in man, be survived in about 50 per cent of the cases; in many instances, moreover, there was entire absence of symptoms of thyroid as well as of parathyroid insufficiency.

Only now that the function of the thyroid gland and the parathyroid glandules may no longer be so confounded, are we in a position to determine the amount of each of these organs likely to be necessary in a given case to prevent the occurrence of symptoms of deficiency of either. And even before this has been more definitely determined surgeons are justified in proceeding with greater intrepidity in operation involving the sacrifice of the thyroid and threatening the destruction of the parathyroid glands, believing that the symptoms of privation of each may be mitigated or entirely negatived by the administration in some form of the nucleoproteids or whatever substances are lacking.[3]

In the meantime our plan of operating not only for the exophthalmic or hypertrophic forms but also for the colloid, degenerative or atrophic varieties of goitre may be modified in conformity to our recently acquired knowledge of the function of the glandulae parathyroideae. In place of the unilateral operation, heretofore almost exclusively practised in cases of colloid or other nonhypertrophic varieties of goitre, a bilateral operation might be substituted in some cases; and in the hypertrophic goitres, the one lobe should be so operated upon, that, in case of need, the other may be subsequently attacked without danger of parathyroid privation. Even in the absence of the existing vital reasons which contraindicate the sacrifice of a single parathyroid glandule, the fact that these little organs perform some highly important function is sufficient reason for the endeavor to preserve all of them.

Although for more than a decennium we have known that operative tetany is due to loss of parathyroid tissue more cases of this affection have followed operation during this time than in the preceding quarter century; and, furthermore, at the hands of the operators most experienced in the surgery of the thyroid gland.

[3] The patient suffering from hypoparathyreosis whose history is reported in the July number of the American Journal of Medical Sciences is rapidly being restored to health by the administration, hypodermically, of the nucleoproteids of the parathyroid glands of beeves, supplied me, most kindly, by Prof. S. P. Beebe, of Cornell, N. Y.



Parathyroid Glandules.

Dr. MacCallum, who has carefully studied the operative material from about 80 cases of exophthalmic goitre operated upon by the writer, reports having found in perhaps seven instances one parathyroid with the excised lobe. During the past two years this glandule has only twice, I believe, been excised by me with the thyroid lobe. Nevertheless it is quite certain that in most instances of complete excision of one thyroid lobe as reported by surgeons the world over both parathyroid glandules of the operated side have been sacrificed whether the trunks of the thyroid arteries were tied at some distance from the gland or the ultimate branches of distribution at their points of entrance into the thyroid lobe; and even when that portion of the thyroid in which the parathyroid glandules are quite uniformly found has been resected and left undisturbed, the latter bodies were undoubtedly often destroyed.

It is in the control of haemorrhage that we sacrifice the parathyroid glandules. But the haemorrhage must be controlled and thyroid vessels must somewhere be divided in the operation for the removal of a lobe of the thyroid gland. May they be so divided and secured as not to cut off the blood supply of the parathyroid glandules? Reply to this question is impossible without definite knowledge of the blood supply of these little bodies.

Dr. Mall did me an invaluable service in recommending Mr. Herbert M. Evans, of the class of 1908 of the Medical School of The Johns Hopkins University as one particularly well equipped for making the investigations. Mr. Evans[4] undertook the work with enthusiasm, being interested both in the anatomical and the surgical aspect of the problem. Upon his report, which precedes, this paper is based.

The Situation of the Parathyroid Bodies.—Their position in man is, in general, much lower than in dogs, the higher of the two glands of one side being, on the average, about at the level of the junction of the upper and middle thirds of the lateral lobe of the thyroid gland. Occasionally a parathyroid is found as high as, or even above, the superior pole of the thyroid gland. In one instance at the operating table I happened to find a parathyroid above the level of the superior pole of the thyroid gland. The lower of the two glandules, rarely as high as the middle of the thyroid lateral lobe, is usually not far from the lower pole, but may be several centimetres below it—even within the bony thorax. With great regularity these little epithelial bodies are situated on or very near the posterior border of the lateral lobe of the thyroid gland and more or less in line with an important landmark, the "channel" of anastomosis between the superior and inferior thyroid arteries.

[4] In another communication Mr. Evans will give in greater detail the result of his study of the circulation of the parathyroid glandule.

The Blood Supply.—As determined by Mr. Evans, each glandule has invariably its special artery which might be designated the superior and inferior parathyroid artery right and left. This little vessel surprises one by its size, being large in proportion to the organ supplied, and thus aids in the identification of the epithelial body. The parathyroid artery is particularly serviceable as a guide to the parathyroid gland when the latter is enveloped in fat. Ordinarily these glandules are quite free and, as cherries on the stem, hang from the artery which, as described by Mr. Evans, enters its "hilus."

The usual shape of the bodies is indicated in the drawings. They are ordinarily ovoid and flattish, presenting a sharpish edge which may as a rule be easily curled or folded. The surface markings which give the glandule an exceedingly fine, barely visible granular appearance are probably due to the blood vessels. Differentiation from adipose or thyroid tissue is rarely difficult unless the natural appearances have been obscured by trauma or staining.

To Save the Parathyroid Glands in Performing Thyroid Lobectomy.—We have seen that from the superior and inferior thyroid the parathyroid arteries almost invariably arise, but we may assume that by the way of the oesophageal or other branches of anastomosis a number of parathyroid glands have been rescued; otherwise it would be difficult to explain the large percentage of recoveries which followed simultaneous ligation in man of all four of the thyroid arteries in the total excisions of a quarter of a century ago. It is important to note that these excisions were not undertaken for the hypertrophic forms of goitre.

Total extirpation performed in this manner in cases of Graves' disease would, perhaps, rarely fail to be followed by tetany. But it frequently happens that more than one lobe, or indeed that the greater portion of both lobes has, in two or more acts, to be removed in hypertrophy of the thyroid gland.

The "subcapsular" procedure of Dr. Charles H. Mayo is, I believe, correct in principle, and, with the proper observance of details, for knowledge of which we are indebted to more complete acquaintance with their vascular supply, one or perhaps both parathyroid glandules of a side may be saved. But only with the exercise of the greatest caution; for, between the point at which the branch giving off the parathyroid artery enters the thyroid lobe and the origin of the latter vessel, there may be hardly room for one fine pointed artery forceps and not space for a broader-nosed clamp, as, for example, the admirable instrument of Ochsner; and still less for two clamps.

On two occasions, recently, in the operation for exophthalmic goitre, there was not room even for the fine point of our "mosquito clamp," and twice

I deliberately cut off the blood supply of the inferior parathyroid gland, seeing no alternative save preserving a portion, too considerable, of the thyroid lobe. On several occasions, operating for exophthalmic goitre, I have transplanted into the thyroid gland a parathyroid glandule which had been deprived of its blood supply.

The drawings of Mr. Evans happen to be made from specimens which do not illustrate this point particularly well; but in Fig. 60 and Plate LXXIX the inferior parathyroid is given off from a branch of the inferior thyroid artery only a few millimetres from the point at which the latter penetrates the thyroid gland. In Fig. 61, also, the inferior glandule, a centimetre or more below the inferior pole of the thyroid gland, might easily be deprived of its blood supply if its artery were not recognized in the course of the operation. There is room in this instance for the application of two ordinary artery clamps distal to the point of origin of the parathyroid arteriole; but it should be observed that a nicely injected, carefully dissected specimen makes plain conditions which, in the course of an operation, might be overlooked. The remaining glandules of the illustrations might with care escape destruction, for their arterioles are very short and arise in the main from the anastomotic channel or quite near to this vessel.

The term "subcapsular" expresses the operation of ultraligation very well, it seems to me, and I find it exceedingly convenient. It may be objected that there is normally no demonstrable capsule underneath or in the plane of the blood vessels of the thyroid gland, but the term proposed by Mayo is, nevertheless, not confusing and will not easily be relinquished. As a matter of fact, there is not infrequently in cases of goitre an intimate capsule enmeshing the vessels, which cannot only be seen during the dissection but demonstrated thereafter.

The Operation of Ultraligation in Exophthalmic Goitre.—The operation of ultraligation or ligation beyond the origin of the parathyroid arterioles is quite simple if properly performed, but may prove very difficult if not. The skin incision is usually made to correspond with one of the transverse lines of the neck, its length depending upon the size of the goitre and upon the height of the superior pole of the thyroid. For a better cosmetic effect, in the case of women, we often determine the precise line for the incision with the patient in a sitting posture, consulting her as to the fall of the necklaces which she wears with evening dress. If the line is prescribed in the recumbent position the scar may fall too low. The platysma muscle, carefully reflected upwards in the skin flap, may be divided at a slightly higher level than the skin. In the dissection of this flap and indeed throughout the operation the injury to veins should be avoided as studiously as possible. A

vertical, mid-line incision through the fascia is carried only deep enough to enable one to raise the sternohyoid and omohyoid muscles. It is an excellent suggestion of Dr. Charles Mayo's to divide these muscles near their hyoid insertion, and between clamps which are not removed until it becomes necessary to do so, to permit the placing of the muscle suture.

It has not been my practice, however, to include in these clamps the sternothyroid muscle. I believe that one is less likely to stain the deep wound if the sternothyroid muscle is carefully divided by itself after the hyoid muscles have been reflected, and in such a manner as not to cause the rupture of the fine and easily torn vessels which one encounters in raising this thinly spread out, capsule-like muscle from the thyroid gland. Moreover, one cannot reflect the omohyoid and sternohyoid muscles to so high a point if the sternothyroid muscle is included. The latter muscle being well divided and the previously severed muscles forcibly reflected by means of the strong muscle clamps, one may gently raise the thyroid lobe from its bed on a spatula-like knife handle carefully insinuated between the delicate blood vessels just coming into view.

Contrary to the universal custom, I do not, as a rule, complete at this moment the full delivery of the entire gland, for fear of soiling, but grasp very firmly between thumb and finger the superior pole and pull it forwards and towards the mid-line far enough to make the ultraligation of the superior thyroid vessels perfectly easy. Attempts to completely dislocate the entire gland or the inferior pole in this manner at this stage of the operation may cause the rupture of some delicate blood vessels and consequent staining of the field containing the parathyroid glandules. But, if judiciously done in the manner described, the superior pole may be fearlessly grasped, because at this horizontal level there are no vessels behind the superior pole likely to be torn. When the superior thyroid vessels have been safely passed by the thumb or finger one may proceed with considerable roughness and without fear of haemorrhage to dislocate even the highest and deepest superior pole.

This grasp of the upper portion of the lobe putting on stretch the superior thyroid vessels must not be relinquished until released by the ultradivision of the finest branches distributed to the thyroid gland in the vicinity of the superior pole. The upper end being thus liberated, the delivery of the entire lobe is continued and without the tearing of the blood vessels. From this step on, throughout the operation, until the last vessel has been divided the thyroid lobe must be firmly drawn towards the opposite side, alternate relaxation and compression and undue pressure on the trachea being carefully avoided. From above downwards and from before backwards the ves-

sels as they bind or as they present must be clamped and divided at their point of entrance into the gland, as far peripherally as possible.

Except in the case of the larger branches, it is usually unnecessary to clamp the distal end of the cut vessel, haemorrhage from the gland side being prevented by the pressure exerted on the thyroid lobe by the unremitting traction towards the opposite side of the neck. By this method the recurrent laryngeal nerve, usually seen, is little endangered. In the course of the liberation of the lobe the nerve may be dragged well to the front of the trachea: of the right nerve this is particularly true. When in the immediate neighborhood of this nerve, at what might erroneously be termed the hilus of the thyroid lobe, one plunges the sharp-pointed clamps into the thyroid gland, seizing the binding vessels after they have disappeared from view in its substance. When the habit is well acquired little if any time is lost by practising the clean, bloodless method of operating for goitre. The operation can be carefully performed in about the time required for its detailed description. For the removal of a thyroid lobe in a moderately difficult case of exophthalmic goitre, ten minutes is ample time if the experienced, skillful operator is well assisted.

I am not convinced that very light general anaesthesia with ether skillfully given by an expert anaesthetist for only 15 or 20 minutes is less safe, even in the gravest cases, than local anaesthesia plus the prolonged operative period and its attendant nerve strain. In operations for exophthalmic goitre the general anaesthesia should be administered only by an expert.

A nurse trained in the prae- and postoperative care of cases of Graves' disease should be in charge, and the patient should have a private, quiet room. We have knowledge of no analogous disease, and of no toxaemia comparable to that which follows operation upon people afflicted with hyperthyroidism. It is, therefore, particularly difficult for the uninitiated to realize how critical is the condition of so many of these patients until, as a demonstration, a death has been experienced.

As so impressively pronounced by Dr. Mayo at his clinic, saturation of the patient with water must be accomplished in one way or another. The surgeon must not accept excuses that water could not be given by mouth because it hurt the patient to swallow, and not by the intestine because the guttatim injections were expelled, unless the patient is uncontrollable; in such event prompt resort to subcutaneous infusion must be had.

Chilling or Freezing the Neck Before and After Operations for Graves' Disease.—It had not occurred to me until the end of June, a few days before leaving town for the summer, that excessive cold applied to the neck in these cases, particularly after operation, might delay the processes of repair and

absorption and thus bridge over the period of greatest danger, the two or three days succeeding operation. Its employment was very imperfectly tested in three instances, but in all with beneficial results, it seemed to me, although one of the patients, desperately ill before operation, did not recover. In no instance, unfortunately, did we succeed, with the inadequate appliances at our disposal, in doing much more than slightly cool the surface of the skin. In one case, 36 hours after operation, the pulse which had been steadily rising until it reached 180, dropped 30 beats per minute within one and one half hours of the application of the cold. In another, a good night's sleep, the first in weeks, seemed to be attributable to the application of cold to the neck. It is quite possible that harm rather than good might be done by ineffectually applied ice bags. They might serve as a poultice if, for example, swathed in protecting flannel, or if negligently attended to. The danger of reaction, too, must be constantly borne in mind—the reaction following either a brief or a prolonged use of the cold. Therefore no time should be lost in changing the packs; and ultimately the cold should gradually be withdrawn. I doubt the ability of the rubber ice bag to produce a degree of cold sufficient for the very ill cases; or the non-conducting rubber should, perhaps, be so thin that rents would be hardly avoidable. In some cases a degree of cold low enough almost to freeze the skin might be necessary. Possibly to be considered as a method of treatment for desperately ill cases is an unclosed wound constantly irrigated with water of the desired temperature.

I am convinced that the toxaemia is not simply due to the absorption of thyroid secretion. Otherwise might not the gravest cases of exophthalmic goitre be safely treated by total excision of the thyroid gland? It is my belief that the toxaemia incident to wound healing is badly borne by the subjects of hyperthyroidism. On several occasions, soon after thyroid lobectomy, I have seen prompt and great improvement follow the liberation of a drachm or even a few drops of reddish serum from the wound. Moreover, the typical postoperative toxaemia may, it seems, follow operations of other kinds upon patients afflicted with Graves' disease. Absorption takes place continuously during the process of repair, even in wounds which are "dry" and healing throughout by first intention. Thus it seems to me quite reasonable to hope that something, perhaps much, may be accomplished by the adequate employment of cold. The entire neck fore and back and sides, and from chin to chest might be made so cold in the serious cases as to arrest for a time, more or less completely, the process of absorption and possibly of healing.

Furthermore, if absorption from the wound is, even in a measure, responsible for the toxaemia so badly borne, the area of the wound surfaces must

be a factor influencing the result; and, if so, there would be in this an indication for as small a wound as feasible in certain cases. A vertical skin incision to avoid reflection of a flap might be tested and less complete division of the muscles at their attachment to the hyoid bone might suffice for the liberation, in the manner described in this paper of the superior pole. The operation of ultraligation might thus be effected through a hole just large enough to permit the delivery of the lateral lobe of the thyroid gland.

AUTO- AND ISOTRANSPLANTATION, IN DOGS, OF THE PARATHYROID GLANDULES[1]

As regards the preservation of form merely, transplantation of the parathyroid glandules has been successfully undertaken by several investigators. In combination with the thyroid gland, and before the remarkable discovery by Gley and by Vassale and Generali of a vital function for the parathyroid glandules, v. Eiselsberg, in 1892, in experiments which have become classic, made transplantations of these bodies which were not only successful morphologically but also from the functional point of view. The correct interpretation of his results, of the tetany which followed the extirpation of the transplanted thyroid gland, could not even be surmised until about four years later. Enderlen in 1898 and Payr in 1906 transplanted, with morphological success, the "epithelial bodies" as they happened to be included in the thyroid grafts. Transplantation of the isolated parathyroid glandules was undertaken by Camus as early as 1904 (Leischner) and Christiani reports in 1905 that the transplanted epithelial bodies of a cat had undergone little change in five years. The first to obtain functional proof by their transplantation was Leischner.[2] His experiments were performed on rats, the donor of the glandules being the donee. He used about 80 rats in the investigation and reports eight cases in which functional proof seems to have been obtained. My work on transplantation of the parathyroid glands in dogs was begun in the autumn of 1906, and has been continued, interruptedly, until the present time. It was undertaken with a view to determine the course to be pursued by the surgeon when a parathyroid gland has been accidentally removed or deprived of its blood supply, and in the hope that it mght be attended with such success as to justify the attempt to transplant this glandule from man to man. In the course of the work many questions have arisen, and we find ourselves still hardly beyond the threshold of the investigation. In a patient suffering greatly from subtetanic hypoparathyroidism as the result of two operations by myself upon a large colloid goitre which produced distress from pressure, tetany has for three

[1] Received for publication November 9, 1908. Presented at the Society for Experimental Biology and Medicine, New York, April 15, 1908.

J. Exper. M., Lancaster, Pa., 1909, xi, 175-199. (Reprinted.)

Also: (Abstr.) Proc. Soc. Exper. Biol. and Med., N. Y., 1908, v, 74-77. (Reprinted.)

Also: Proc. Path. Soc., Phila., 1908, n. s., xi, 109-114. (Discussion 127.)

[2] Leischner, Archiv für klin. Chir., 1907, lxxxiv, 208.

years been averted and the status parathyreoprivus made endurable by the feeding of parathyroids, by hypodermic injections of the nucleoproteids of the parathyroid gland (Beebe) and for almost one year by the administration of calcium lactate (MacCallum and Voegtlin).[3]

My first transplantations in dogs of the parathyroid glands,[4] and the first of which I know, were made into the thyroid gland of the donor; next into the spleen, on the announcement by Payr of the successful transplantations of the thyroid gland into this organ; and finally (1907-1908), on the appearance of Leischner's contribution (von Eiselsberg's clinic), within and behind the musculus rectus abdominis, and in the mid-line, praeperitonaeally.

Pfeiffer, Hermann, and Mayer[5] have made two successful autotransplantations in puppies.

Biedl, commenting on the unsuccessful attempts of Foges, Kreidl, and himself to transplant ovaries, testicles, and suprarenal glands, contrasts these failures with his success in transplantation of the parathyroid glands. He states that a year prior to his report[6] he transplanted in two dogs into the spleen "foreign" parathyroids, and "after a time" removed both thyroid lobes as well as the parathyroids. One animal lived seven months without a trace of tetany and finally died of what seemed to be "cachexia thyreopriva." The spleen contained, the report states, two well healed, intact parathyroid glands. The second dog had tetany of short duration. It recovered, however, entirely, still lives, and consequently has, the author believes, parathyroids in the spleen which are functionally sufficient.

With the exception of the two cases of Biedl, I find no report of the successful isotransplantation of the parathyroid glands, and besides my own the only successful autotransplantations of these glandules in dogs are, perhaps, the two in puppies reported by Pfeiffer, Hermann, and Mayer. As to the success of the isotransplantations of Professor Biedl, I confess to a little surprise in view of the fact that it is quite out of accord with what one, *a priori,* would expect, and is also at variance with the results of my experiments; and for the following reasons: (1) Parathyroid deficiency was not created by Professor Biedl either prior to or at the time of the

[3] Reference has been made to this case in previous publications. In the two operations only one parathyroid gland was removed (specimens examined by Dr. MacCallum and myself), and this little body was recognized the instant the final resection-cut into the right thyroid lobe was made. It was not until six months later, in the autumn of 1906, that it occurred to me to attempt the transplantation of the parathyroids.

[4] Hypoparathyreosis, Status Parathyreoprivus and Transplantation of the Parathyroid Glands, Amer. Jour. of Med. Sciences, 1907, cxxxiv, 1.

[5] Mitteilungen aus den Grenzgeb. der Med. und Chir., 1907, xviii, 377.

[6] Wien. klin. Woch., 1908, xxi, 304.

transplantations—not until "after a time." (2) *Two* of the glandules were transplanted in each instance and *both* are said to have lived and performed their function. If this were the case the dogs must each have been possessed for a time of six functioning parathyroid bodies. (3) The transplanted glandules were "foreign." I cannot, with my present views, quite credit the observation that an animal in full possession of an organ or set of organs whose function it is to furnish an internal secretion is capable of sustaining in a functioning state a second organ or set of organs of the same kind, and particularly not when these transplanted organs are of "foreign" origin. (4) The functional proof is lacking inasmuch as the glandules were not excised during life.

The results of the experiments undertaken in the winter of 1906-1907, and of a portion of those made in 1907-1908 have, previously, been reported in briefest abstract.[1] Since the publication of these reports there have been developments, the result of further experimentation, which should be recorded. The cases of especial interest will be considered in some detail, the remainder recounted in the briefest manner.

Sixty dogs, approximately, have been used in this investigation and more than 130 parathyroid glands transplanted. The technique has been precisely that of the operating rooms of The Johns Hopkins Hospital.

Of the first series, performed in the winter of 1906-1907, there follow brief notes, with comments, of a selected few of these experiments which, interpreted in the light of my work of the following winter, contribute something to our knowledge.

Dog A.—*January 15, 1907, Operation I:* Autotransplantation into thyroid lobes. Excised the four parathyroid glandules, leaving, perhaps, a film almost too fine for ocular demonstration, of the left internal one, on the thyroid gland. Three of the glandules were replaced, in new situations, in the thyroid lobes.

February 25, 1907, Operation II: Excision of such parts of the thyroid gland as were believed to contain the transplanted bodies. Only one of the autoplants or autografts, was found. It was smaller, harder and less red than the normal parathyroid gland. *Microscopic examination:* The nuclear staining is excellent. The transplanted epithelial body seems altogether normal except that a little reactive fibrous tissue surrounds it and, here and there, in delicate strands, enters it. It is obviously difficult to furnish convincing evidence of functional proof.

As the dog had no symptoms of tetania parathyreopriva after the first operation, we are inclined to believe that the film of parathyroid tissue left on the thyroid gland in the process of shaving off the left internal parathy-

[1] Proceedings of the Path. Soc. of Philadelphia, 1908, xi, 109; Proceedings of the Soc. for Exper. Biol. and Med., 1908, v, 74.

roid was sufficent to hold them in check until one of the much needed autografts had obtained its new blood supply and resumed its function. That only one of the transplanted glandules lived surprised me at the time of the observation, when I had hoped to find all three of them surviving, but this is the finding which, with my added experience, I should now be prepared for. I am anticipating a little in making at this point the statement that only one of the transplanted parathyroid bodies in a given animal, has in our researches survived; and furthermore that only so much of the successfully grafted epithelial body has lived as seemed essential to prevent pronounced symptoms of tetany, and not enough of it to entirely obscure evidence of hypoparathyroidism, such as a slight fibrillary tongue tremor.

Dog E.—*January 23, 1907, Operation:* Autotransplantation into the spleen. The two glandulae parathyroideae of the right side of the neck and the superior glandula parathyroidea of the left were excised and planted into the spleen.[8] The left thyroid lobe was also excised to insure destruction of the fourth glandula parathyroidea which was not seen.

January 25, 1907.—Tetany.

January 26, 1907.—Dead. *Autopsy* negative. Death believed to be due to tetania parathyreopriva.

Dog G.—*January 28, 1907, Operation:* Autotransplantation into the thyroid lobes. The internal left parathyroid glandule was excised and reimplanted into the left lobe of the thyroid gland. The superior (external) right parathyroid glandule was implanted into the right thyroid lobe near its anterior border, about 1 cm. above its inferior pole.

February 8, 1907.—Dog has not been at all well since the operation. Believed to be suffering from parathyroid privation due to the considerable insult to both thyroid glands as well as to the excision of two transplanted bodies.

May 8, 1907.—One hundred and nine days since the transplantations; killed. *Autopsy:* There is no trace of the transplanted bodies, except a little pigment at the site of the transplantation of each.

This case is cited as evidence favoring the view that the thyroid privation was either insufficient or not sufficiently long continued to insure success for the transplantation. The restoration of function in the maltreated, but nontransplanted glandules, may have taken place too rapidly to admit of the return to life of either of the two transplanted bodies.

Dog H.—*February 5, 1907, Operation:* Searched neck carefully and did not find a single parathyroid glandule. It is the only time that I have had this experience. Probably to be explained, in part at least, by careless operative technique.

[8] The technique of the splenic transplantations is described and illustrated in the first article published by me on the subject of transplantation of the parathyroid glandules in dogs, Amer. Jour. of Med. Sciences, *loc. cit.*

February 8, 1907.—Has not been well since the operation. Is very thin. Slight fibrillary tremors.

The experiment is cited to show what I observed very frequently in my experiments in transplantaton and extirpation of the thyroid gland in 1888-1889,[9] that mere handling of the thyroid lobes may give rise to symptoms of parathyroid privation. Manipulation, not excessive, of the thyroid gland, in dogs, has several times in my experience produced fatal tetany.

Dog N.—*April 10, 1907, Operation I:* Isotransplantations. Into the spleen were placed five parathyroid bodies taken from three or possibly four dogs. The transplantations all took place very smoothly by means of the needle and thread method described in a previous article (*l. c.*). Some of the glandules were kept in blood serum for, possibly, half an hour. The last obtained were, however, promptly transplanted. Parathyroid deficiency was not created.

April 16, 1907, Operation II: Panthyroidectomy performed on both sides in such manner as to remove or destroy the blood supply of the parathyroids. Dog was rather weak before this operation. His cage companion of a few days before had died of distemper. I was not aware of this until after this operation.

April 17, 1907.—Dog has tetany; evidenced by general tremors and rigidity.

April 18, 1907.—Barely able to stand; very emaciated. The tremors observed yesterday are not demonstrable today. Trousseau's phenomenon cannot be elicited. Has cough, and from the nose is a discharge of blood-tinged mucus. Vomits. Gave hypodermic injection of one phial (m xii) of a protonucleid extract of parathyroid gland kindly sent me by Dr. Beebe for the patient so often referred to by me. Dog is being fed chiefly on milk.

April 19, 1907.—No tremor nor spasms nor stiffness and dog runs about with surprising activity considering the great emaciation. Cough persists; also the discharge from nose.

April 20, 1907.—1.30 p. m. Dog much worse. The signs of tetany have all returned. Fell in tonic spasms with all four legs drawn to belly and toward mid-line, reminding one of the comparison to the obstetrician's hand in cases of tetany in the human subject. Second injection of nucleoproteid (Beebe).

April 22, 1907.—Dog weaker than ever and greatly emaciated. Can, however, stand and totter about. Laps water in characteristic way, for minutes at a time, without lowering the level of the water in the basin.

April 23, 1907.—Died last night. *Autopsy:* Each pleural cavity contained about one pint of blood-stained, slightly purulent fluid. Peritonaeal cavity negative. The spleen was carefully sliced. One little necrotic body, smaller than and with the color of a mustard seed was found in the spleen near its surface, otherwise only a blood stain here and there remained as traces of the transplantations made two weeks ago.

[9] An Experimental Study of the Thyroid Gland of Dogs, with Especial Consideration of Hypertrophy of this Gland, Johns Hopkins Hospital Reports, 1896, i, 373.

The protonucleid extract (Beebe) was used in two of the dogs with tetany and with some effect, it was thought. The above dog lived six days after removal of his parathyroid glands, a long time considering the finding in the pleural cavities. Possibly the absorption of the five isoplants as well as the administration of the Beebe extract influenced the result. It can well be objected in this case that the glandules, or at least three of them, used in the isografting were not transferred to the spleen with sufficient promptness, and that their failure to survive was due in part to distemper and the thoracic complication.

In operations involving a large number of dogs and so many operating tables I was assisted by my house surgeon, Dr. Sowers, and by several other members of my hospital staff who made possible such an undertaking without delay and with the observance of a technique almost above criticism. Quite a large piece of the thyroid gland was usually excised with its internal epithelial body to support and thereby facilitate the cutting of the latter; but only a small piece of the former remained in the isograft as prepared for the transplantation. The transplantations were on the whole very smoothly done.

Dog O.—*April 24, 1907:* Heavy, vigorous, young fox terrier. Estimated age one and a half years. *Operation I:* Isotransplantations, into spleen, of eight parathyroid glandules obtained from five dogs. The glands to be grafted were given a raw surface when external, cut with thyroid tissue when internal and each kept in the blood serum appertaining to it. Parathyroid deficiency not created until nineteen days later.

April 25, 1907.—Dog is doing well.

April 26, 1907.—Has appetite and runs happily about.

May 7, 1907.—Perfectly well and vigorous.

May 13, 1907, Operation II.—All thyroids with parathyroids excised.

May 14, 1907.—8 a. m. Already severe tetany. 2 p. m. Severe symptoms have abated. Has tongue tremors still and laps water in the characteristic way. Refuses food.

April 15, 1907.—4.30 p. m. Extremities quite rigid. Fine tremors. Beebe's nucleo-proteid injected (about 10 minims). 4.45 p. m. Dog seems definitely brighter. Laps a little milk effectually. Stands up quite naturally. Fine tremors of tongue and of shoulder muscles persist. Refuses meat.

April 16, 1907.—Found dead. *Autopsy* negative. Peritonaeal and thoracic cavities normal. Spleen very carefully examined. The isografts have all been absorbed. Not a trace of them remains. At the surface of the spleen within the area of transplantation, a tiny white speck which we thought might possibly be the remains of a graft was preserved for microscopic examination. It proved to be nothing but fibrous tissue.

This case is one which, perhaps, above all others convinced me of the inadvisability at this time of further attempts at transplantation without the production of a parathyroid deficiency. I had not as yet ascertained that

for isografts the likelihood of survival is, to say the least, very little. I have hoped for an opportunity to test isografting between dogs of one litter.

Results (Winter of 1906-1907);[20] *Autotransplantation.*—A degree of parathyroid deficiency is of necessity created in the autotransplantations. Of five autografts into the thyroid lobes of three dogs, two were successful (macroscopic and microscopic proof). Of eight autografts into the spleens of three dogs, one only succeeded (macroscopic proof). In no instance was functional proof of the success of these transplantations obtained. Such proof cannot, of course, be convincingly obtained in the cases of transplantation into the thyroid because of the lack of certainty that no parathyroid tissue except that transplanted remains at the time of the final operation, at which well nourished thyroid tissue, sufficient to insure the life of the transplanted parathyroid gland, must be left.

Isotransplantation.—In five cases Dogs (K, L, M, N and O), two, seven, five, five, and eight parathyroids, respectively, were transplanted into the spleen. In only one dog (K) was a parathyroid deficiency created. In no instance was the transplantation successful; furthermore, tetany supervened and death occurred just as promptly, after removal of the thyroids and parathyroids in the neck, in these dogs with so many intrasplenic isoplants, as in the ungrafted dog. Hence we conclude that, in this instance, life was probably little, if at all, prolonged by the absorption of the parathyroids transplanted into the spleen.

The Technique of the Transplantation behind the Rectus Abdominis Muscle.—In the earlier transplantations the autografts, whether in the mid-line or behind the Musculus rectus abdominis, were, as a rule, placed either at the bottom of the wound or in its immediate vicinity with the view that, in the ultimate search for them, proximity to the wound would facilitate their discovery. It was, however, soon noted that the glandules behind the rectus muscle could distinctly be seen through the several layers of delicate and trasparent fascia, namely, the posterior sheath of the muscle, the subperitonaeal fascia and the peritonaeum. They would instantly be detected from a mid-line wound on reflecting outward the abdominal wall. It became then our established procedure (1) to make an incision 1 cm. or less in length through the aponeurosis in front of the Musculus rectus abdominis over the

[20] In 1906-07, I was assisted by members of my house staff and by medical students, especially Messrs. Chesnutt and Dinsmore; this year Dr. Hennington has rendered me great service in the operative and kennel work. The vicissitudes have been many—pneumonia, distemper, accidents, and escapes. On one occasion the laboratory was broken into, presumably by a discharged employee, and many of my most prized dogs set at large. Some of these dogs were awaiting the ultimate functional test of the transplantation after two or more operations.

inner edge of this muscle; (2) with the blades of our fine "mosquito-forceps," to liberate this border of the muscle from the mid-line fascia; and (3) with a second pair of this forceps, to introduce the glandula parathyroidea between the widely separated blades of the first, to as high a point as feasible behind and within the sheath of the rectus muscle. In this manner the autograft is carried an inch or two above the line of incision through the anterior sheath of the muscle and well out of the sphere of influence of a possible drop or fraction of a drop of blood. The glandules successfully transplanted in this wise produced, except in one instance, no opacity of the fasciae through which they were to be observed, and, at a glance, were discoverable under the glistening lining of the abdominal wall. The incision through the aponeurosis anterior to the Musculus rectus abdominis was closed with one mattress suture of China bead or the finest black silk. Over this the skin was brought together with sub- and intracutaneous and epithelial stitches. The abdominal wounds healed *per primam* without exception. The wounds of the neck were very carefully closed with continuous layer-sutures of the finest black silk (A or O) in a milliner's needle. Oozing points were included in the sutures, of which there were usually five or six rows—one each for (1) the mid-line muscles; (2) the deep fascia and muscle sheath; (3) the platysma and deep layer of superficial fascia; (4) the deep cutis and superficial layer of superficial fascia; (5) the mid-cutis; (6) the epithelium. The stitch which we designate as "epithelial" is particularly useful in the surgery of animals. It excites no irritation and includes so little more than the cuticle that it is finally shed with the latter, unless it, previously, be peeled or ripped off. The sewing with the fine straight needle may be accomplished with unusual rapidity. Aseptic precautions, thanks to the skillful assistance of Dr. C. W. Hennington, were throughout as perfect as we could make them. With perhaps five exceptions the neck wounds healed throughout *per primam*. It was chiefly in connection with the second operations carried out in the line of the original wound that the suppurations occurred.

Dog 1.—*February 3, 1908, Operation I:* Excised the superior, right parathyroid gland and transplanted it into the right rectus abdominis muscle. There was no bleeding. Excised the right thyroid lobe entire. Layer suture with black silk, collodion dressing.

February 9, 1908.—Convalescence without incident. Both wounds healed *per primam*.

February 10, 1908, Operation II: Transplanted a small, freely movable parathyroid gland found resting on the thyroid gland, about midway between its poles, into the left rectus abdominis muscle. Excised the left thyroid gland, entire. The dog is now probably deprived of all parathyroid glands except the two transplanted ones.

February 11, 1908.—Dog fairly well. No fibrillary tremor of tongue. No muscle twitching.

February 12, 1908.—No definite sign of tetany.

February 13, 1908.—10 a. m. Dog very ill. Respirations 160-180 per minute. Pulse too rapid to be counted. Blood-tinged foam at mouth. Walks a few steps then falls and crawls with head close to the floor. Typical tremors. About 2 p. m. great improvement and at 6 p. m. nearly complete recovery. Pulse 120.

February 14, 1908.—10 a. m. Quite ill. Fibrillary tongue tremors, and clonicotonic contractions of temporal and other muscles; characteristic gait. 5 p. m. calcium lactate, 4 grammes, in water administered per stomach tube by Dr. Voegtlin. Marked relief after one and a quarter hours.

February 15, 1908.—Condition about as it was yesterday, before the exhibition of the drug. Calcium lactate again administered, and with difficulty, for attempts to pass the stomach tube excited convulsions. Improvement.

February 16, 1908.—Sunday. Dog observed but once. Little if any better.

February 17, 1908.—Definitely worse. Very ill. Calcium lactate administered for the third time. Prompt and marked improvement.

February 18, 1908.—Better. Fibrillary tremors of tongue. Calcium lactate, fourth dose. Beneficial effect.

February 19, 1908.—Improved. Tongue tremors persist, but are fainter. Calcium lactate, fifth dose.

February 20, 1908.—Dog much better. Calcium lactate, sixth dose. Benefited.

February 21, 1908.—Fairly well. Trace of tongue tremor.

February 24, 1908.—No calcium for four days. Dog not so well. Marked tongue tremor and slight general muscular twitching. Calcium withheld.

February 25, 1908.—Better. Tongue tremors.

February 27, 1908.—Improving, active. Slight tongue tremors.

March 2, 1908.—Much improved. Gaining in weight. Tongue tremors persist.

March 6, 1908.—Fairly well. Tongue tremors very slight.

March 11, 1908.—Quite well. Tongue tremors still demonstrable. It is twenty days since the last dose of calcium was given, and thirty days that the dog has been deprived of all parathyroids except the ones transplanted.

March 20, 1908.—Dog is becoming much stouter, seems in excellent health. Frisks about as if life were enjoyed. But faint tongue tremor is, still, always to be seen.

March 30, 1908.—Dog is strikingly plump. Faint tongue tremors, and rather general fibrillary twitchings are still manifest on careful observation.

April 4, 1908.—Dog "fat" in the extreme. Contrasted with the other dogs, it seems quite certain that myxoedema has developed.

April 9, 1908.—Normally active and apparently healthy. Continually increasing in size. Thickening of skin and subcutaneous tissue particularly conspicuous in nape of neck. Trace of tongue tremor usually visible.

April 23, 1908.—Myxoedema increasing steadily. Dog somewhat deformed by it.

June 11, 1908.—Dog's plumpness is monstrous and rather uncanny. His hair is falling out. Activity, spirits and general health are good.

June 15, 1908.—Transferred to Drs. Voegtlin and Strouse for observations and experimentation during the summer.

November 1, 1908.—This dog died during the past summer.

The cause of death was undiscoverable at autopsy. Dr. Voegtlin, who observed him carefully, is positive that tetania parathyreopriva did not at any time develop. He will publish a photograph which he took of the animal to show the state of excessive myxoedema, which has so rarely been produced in the dog. The preparations containing, presumably, the autograft and the subaortic accessory thyroid glands were, through a misunderstanding, destroyed by a servant to whom they had been, for a moment, intrusted. We are, therefore, in doubt to which of the two autoplants, in case only one survived, the prevention of tetany is to be ascribed.

It is conceivable, of course, that portions of two or more autoplants may live. This should, I think, be more likely to occur when two glandulae parathyroidiae are transplanted at the same time I am inclined to believe that a very considerable parathyroid privation, greater, perhaps, than is ordinarily produced by the excision of the two parathyroids of one side may be essential to the success of the transplantation.

Dog 2.—*February 3, 1908, Operation I:* Total right thyroparathyroidlobectomy (right panthyroidectomy [11]) and transplantation of the right internal parathyroid gland in the mid-line, just external to the peritonaeum.

March 10, 1908.—Dog has been perfectly well since the operation. Wounds healed *per primam. Operation II:* Total thyroparathyroidectomy on left side and transplantation of the left internal parathyroid gland in the midline, praeperitonaeally. Dog has now, presumably, no parathyroid glands except those transplanted.

March 15, 1908.—Has been perfectly well since the operation. Has manifested no signs of tetania parathyreopriva. Observed once or twice daily by Dr. Hennington and repeatedly by me.

March 18, 1908.—A. m. Observed by Dr. Hennington, who, on careful examination of his tongue, found no trace of tremor.

March 19, 1908.—Found dead in cage late yesterday afternoon. 12 m. *Autopsy:* Blood in nostrils, abdomen slightly distended, normal peritonaeal cavity. Both lungs quite solid, and on section, dark red-black and infiltrated with blood-stained exudate. In the search for the transplanted parathyroid glands two very small brown-red bodies were found in the mid-line subperitonaeally, in the line of the cicatrix, and perfectly isolated from all tissues which might resemble them. They had the color which, as we learned later, is common to the successfully transplanted parathyroid glands. They have, of course, been preserved for microscopic examination (Path. No. 8764).

[11] A word proposed for the sake of brevity, but with some misgiving and disapproval.

Death was quite certainly caused by pneumonia, and the time *post operativum* is too brief for conclusions. The absence of signs of tetany, however, for eight days after the second operation, and the fact that the transplanted epithelial bodies had not become necrotic is evidence in favor of the success of the transplantation. This is the only instance, in our experiments, in which, apparently, two autografts, at least part, have survived. I regret that sections have not as yet been made.

Dog 3.—*February 5, 1908, Operation I:* Autotransplantation of the right external parathyroid into the right rectus abdominis muscle. Removal of the right lobe of the thyroid with the internal parathyroid gland. In Dogs 1 and 2 the rectus muscle was prepared for the transplantation before the parathyroid body was excised, in the belief that the time of exposure of this body to the air might be shortened. But a very few seconds, if indeed any, were saved by this procedure and hence it was abandoned. The epithelial bodies to be transplanted were thenceforth kept in the blood of the wound, sometimes within, at other times without the body, the time required for the transfer rarely exceeding a few seconds. In case of the slightest bleeding a new pocket in the rectus would have been made.

February 20, 1908.—Dog recovered from Operation I without incident. Both wounds healed *per primam. Operation II:* Procedure, precisely as described above, carried out on the left side, except that the internal parathyroid was used for transplantation instead of the external glandule. The dog is thus deprived of both thyroid lobes and for parathyroids is reduced to the two transplanted glandules.

February 23, 1908.—Dog seemed fairly well for forty-eight hours *post operativum.* No signs of tetany could be detected. Found dead today. *Autopsy:* No blood in nostrils. Trachea and bronchi contain blood-stained frothy mucus. Right lung airless, heavy, congested. On section there exudes a bloody exudate. Sections made of the lung indicate a pneumonic process. The autopsy findings are otherwise negative. The parathyroid transplanted February 5th was found on the posterior surface of the right rectus muscle much reduced in size and of a yellowish-brown color. The second gland, transplanted only three days before death, was surrounded by blood clots which may have been responsible for its death as well as, in part, for the death of the animal.

Dog 4.—*February 5, 1908, Operation I:* Right superior parathyroid gland transplanted praeperitonaeally in the mid-line, above the umbilicus. Removal of right lobe of thyroid gland with its internal epithelial body.

February 19, 1908.—Dog perfectly well since operation. *Operation II:* Excised left thyroid lobe with its parathyroid glandules and transplanted, praeperitonaeally, in the middle line, the left superior and inferior parathyroids, the latter being in two parts, contiguous, and each about 1.5 mm. in diameter. Dog deprived of both thyroid lobes and all parathyroids except the transplanted three.

February 22, 1908.—Dog disinclined to come out of cage. Wags tail and stands up when petted. Faint trace of fibrillary tongue tremor.

February 23, 1908.—About as yesterday—a little worse, perhaps.

February 24, 1908.—Cough; muco-purulent discharge from nose which dog constantly licks. Licking of the nose, even when dry, is a characteristic symptom in tetania parathyreopriva. Faint fibrillary tremor linguae. Other muscles not demonstrably affected. Dog decidedly worse, but we have the impression that his illness is not altogether due to hypoparathyroidism.

February 25, 1908.—Calcium lactate, one dose, was given without definite effect.

February 26, 1908.—10 a. m. No tremor, but dog much weaker and very thin. Muco-purulent discharge from nose continues. Died about 3 p. m. *Autopsy:* Abdominal cavity negative. Wounds healed *per primam.* Barely a trace remains of the transplanted parathyroid glands. Left lung negative, except for small central induration. Right lung, lower lobe, consolidated and in state of hepatization beginning to resolve. Pneumonia must have hastened the death of this dog, and possibly was in a measure responsible for the failure of the transplantation.

Dog 5.—*February 5, 1908, Operation I:* Autotransplantation. Right superior parathyroid glandule transplanted behind right rectus muscle. Excised right thyroid lobe with its internal epithelial body.

February 20, 1908.—Dog has been well since Operation I. Both wounds healed *per primam. Operation II:* Left superior parathyroid not found. Left internal glandule planted behind left rectus muscle. Left thyroid lobectomy. Dog reduced to the transplanted glandules.

February 22, 1908.—Dog seems fairly well.

February 23, 1908.—Not so well. Panting respiration.

February 24, 1908.—A. m. Explosive expiratory efforts frequent. Tremors not demonstrable. Neck wound broken down. This is the first instance in these experiments of failure to heal *per primam.* P. m. Tongue tremors very pronounced.

February 25, 1908.—Dog died about 2 p. m. Calcium lactate not administered in this case. *Autopsy:* Thoracic cavity negative except for a remarkable finding in the anterior mediastinum. There is an infiltration of blood, only three or four drachms in quantity, between the pleural leaves and lying chiefly on the pericardium, entirely outside of this sac. The blood-infiltration extends into the left neck to a point hardly above the subclavio-jugular junction. There is nothing to indicate that the blood gravitated from the neck to the mediastinum, for the former is perfectly healed and unstained, and the mediastinal blood staining fails to reach the neck wound by 3 or 4 cm. The mediastinal blood is not infected. It has excited no reaction, and the contiguous serous membranes have their natural lustre. I conclude that some traumatism, a fall or a self-inflicted blow on the mediastinum during recovery from the anaesthetic was responsible for this lesion. The blood extravasation was too slight, it seemed to me, to have been a factor in the death of this animal. A very careful search for the transplanted glandules by Dr. Hennington and myself failed to reveal a trace of either except a minute area of tissue staining. *This is the first dog of the series of autotransplantations, behind or in the musculus rectus abdominis, to die of uncomplicated tetany.*

Dog 6.—Pregnant bitch. *February 6, 1908, Operation:* Autotransplantation. The right superior parathyroid gland planted into the right rectus abdominis muscle. Excision of right thyroid lobe.

April 5, 1908.—Well since operation. Wound suppurated. Gave birth today to five pups. No evidences of hypoparathyroidism during pregnancy or since delivery.

April 7, 1908.—One of the pups, female, found dead. Each thyroid lobe measures 1 cm. in its vertical and 4 cm. in its transverse diameter. The lobes are connected by an isthmus covering one ring and two interannular spaces. The left superior (external) parathyroid is distinctly seen, though very minute. Weight of puppy 232 grams. Length from tip of nose to tips of hind feet, 26 cm.

April 9, 1908.—During the past two days the four remaining pups have died. They had increased little if any in size. The average weight of the thyroid gland in each of these was .055 gram; the average length of the lobes 8 mm. and average width 3.5 mm.

April 11, 1908.—Dog under observation. Retained for completion of the experiment.

Dog 7.—*February 6, 1908, Operation I:* Autotransplantation. The left external parathyroid, situated as low as the middle of the thyroid lobe at its intero-posterior border, was transplanted behind the right rectus abdominis muscle just above the umbilicus. The right parathyroids were not found. Both thyroid lobes were considerably damaged in the search for the abnormally situated parathyroids; neither lobe was excised. The circulation of the unexcised parathyroids was probably much interfered with and thus a *considerable parathyroid privation caused, a factor in my opinion essential to the success of the transplantation.*

February 7, 1908.—9 a. m. Dog feels badly, whereas the three other dogs operated upon for autotransplantation about the same time yesterday seem perfectly well. He not only refuses to leave cage, but lies down immediately when placed on the floor of the room. His gait on walking and trotting is uncertain. No fibrillary tremors of tongue. Pulse 152. 4 p. m. Pulse 128.

February 10, 1908.—Has been slowly improving since last note.

February 15, 1908.—Seems perfectly well. Have at no time observed positive symptoms of tetania parathyreopriva, but believe that he suffered from hypoparathyroidism for several days after the operation.

February 20, 1908, Operation II: Both thyroid lobes excised and, presumably, the circulation of any remaining parathyroid destroyed. The wound was left open on account of a fine fistulous track in the cicatrix from the first operation.

February 22, 1908.—Dog has been quite well since operation. No signs whatever of hypoparathyroidism.

February 26, 1908.—Dog in fair health and spirits. On most careful and prolonged examination very faint fibrillary tongue tremors were observed. Hence the autoplant must have "taken," and, presumably, the parathyroid glandules excised in the double thyroid lobectomy were defunctioned by the first operation.

March 2, 1908.—Dog is lively, quite well and hungry. No signs of tetany although I have the feeling that he is suffering from very slight parathyroid privation.

March 3, 1908.—Quite well. *Operation III:* Laparotomy, to explore the posterior surface of the right rectus muscle *and if possible obtain functional proof of the success of the transplantation.* The transplanted glandule was at once recognized and excised. It was apparently full sized, shimmering clearly through the peritonaeum. Its relation to the surrounding tissues, so far as reaction in them is concerned seemed to be precisely that of the external parathyroids in the neck. It could be slid about as freely as when in its normal position. I was unable to detect any departure from the normal color of the glandule. In this respect it differed from the transplanted glandules, observed before and more frequently later, in which, although functioning, partial absorption and invasion by fibrous tissue had taken place. In these the red hue was toned by yellow and brown.

March 4, 1908.—Dog ill, but no tremors observed.

March 5, 1908.—Very ill. Complete picture of tetania parathyreopriva. *Operation IV.* Isotransplantation of three parathyroid glands behind the left rectus abdominis muscle. Lactate of calcium exhibited.

March 6, 1908.—Dog found dead this a. m. *Autopsy:* Negative as concerns complications. Death attributable to tetania parathyreopriva. A section of this unusually normal-looking autograft is illustrated in Plate LXXXI. That the drawing in Plate LXXXI seems inferior to that in Plate LXXX is due to the fact that the transplanted parathyroid from this dog (No. 7) was overheated in xylol.

Dog 8.—*February 6, 1908, Operation I:* Autotransplantation. The right superior glandula parathyroidea consisted of two distinct portions quite equal in size; the one, the gland proper, the other, a cyst closely attached to and part of it. The right thyroid lobe was not excised, but it became necessary in the course of its investigation to ligate the vessels at its inferior pole. From the left thyroid lobe, also not removed at this operation, an unusually large internal parathyroid gland was excised and transplanted praeperitonaeally in the middle line.

February 20, 1908.—Uneventful convalescence. No suggestion of tetany. *Operation II:* Both thyroid lobes excised in such manner as to include the remaining glandulae parathyroideae. The dog is now reduced to one autoplant.

February 22, 1908.—Well.

February 23, 1908.—Well.

February 24, 1908.—Not quite so well, but signs of tetany not discoverable. Wound healed *per primam.*

February 26, 1908.—Dog becoming weak and thin. Muco-purulent discharge from nose. Trace of tongue tremor.

February 27, 1908.—Condition little changed. Tongue tremor questionable. Discharge from nose a little less profuse, seemingly.

February 28, 1908.—Brighter. Eats with some avidity. Barely perceptible tongue tremor.

March 2, 1908.—Much better, gaining in weight. Eyes clear, nasal discharge has ceased. Faint fibrillary tremors of tongue and occasionally also of temporal muscles.

March 20, 1908.—Dog increasing in size. Myxoedema (?). Mucous membranes pale; slight tongue tremors. Appetite good.

March 30, 1908.—No conspicuous change in condition.

April 4, 1908.—Tongue tremor not observable today. The myxoedema has been increasing.

April 9, 1908.—Seems quite well. Is awkwardly and unpleasantly plump. No tremors.

April 23, 1908.—Hair becoming somewhat thinner.

June 11, 1908.—Myxoedema has increased. Hair is beginning to fall out. State of health apparently unchanged. Transferred to Drs. Voegtlin and Strouse for the summer, who will later report the results of their observations, and of their experiments with three of the myxoedematous dogs of this series.

Dog 9.—*February 6, 1908, Operation I:* Autotransplantation. Right internal glandula parathyroidea planted behind musculus rectus abdominis. The superior glandula parathyroidea is very small indeed and in two parts. The right thyroid lobe was excised.

March 24, 1908.—Autotransplantation behind left rectus of a low-lying superior glandula parathyroidea. A second left glandula parathyroidea was very near the one removed, on the outer surface of the thyroid lobe, below its middle. Left parathyroidectomy. Dog is reduced to the two transplanted parathyroid glands.

March 25, 1908.—Dog seems unaffected by the operation. Is as lively as ever.

March 26, 1908.—About as usual. Faint tongue tremors.

March 27, 1908.—Tongue tremor seen only at times and with difficulty.

March 30, 1908.—Slight tongue and also temporal tremors. Dog not so well.

April 1, 1908.—Better. No signs of parathyroid privation.

April 4, 1908.—In unusually good spirits. No tremors.

May 9, 1908.—Seems very well. No tremors. Has gained in size.

May 23, 1908.—Abnormally stout. Myxoedema (?).

June 11, 1908.—Increasing in size. No tremors. Health seems good. Transferred to Drs. Voegtlin and Strouse for the summer.

Dog 10.—An old dog. *February 10, 1908, Operation I:* Autotransplantation. Right superior glandula parathyroidea transplanted into praeperitonaeal pocket, just above umbilicus. Excision of right thyroid lobe (right parathyroidectomy). The transplanted body is so large that I questioned for a time its nature but finally decided that it must be a parathyroid gland. Its edge was characteristically sharp, and, a little softer than usual, it resembled in consistence and form the human glandule.

February 27, 1908, Operation II: The left internal glandule was transplanted praeperitonaeally in the middle line below the navel. The left supe-

rior glandula parathyroidea is very small. Left panthyroidectomy. Dog is now reduced to the two transplanted glandules.

February 28, 1908.—Faint tongue and temporal tremors.

February 29, 1908.—No tremors observed.

March 1, 1908.—No tremors.

March 2, 1908.—No tremors. Wounds healed *per primam*. Dog better.

March 5, 1908.—A. m. Dog jumps about quite happily in his cage and seems fairly well. P. m. Dog is very ill. Has general muscular twitching and presents the picture of tetania parathyreopriva.

March 6, 1908.—Dog died during night. *Autopsy:* Made and dictated by Dr. Hennington. Heart and lungs normal. On opening the peritonaeal cavity an extravasation of blood into the omentum was observed and, on more complete exposure, a large round worm (*Eustrongylos gigas* or *Dioctophyme renale* (?)), 90 cm. long and 1 cm. in diameter, presented itself free in the peritonaeal cavity in the neighborhood of the spleen. It was still alive and on being placed in warm water, executed slight movements. The intestinal peritonaeum was thickened and granular-looking. The parietal peritonaeum presented in places small, indefinitely circumscribed, roughened areas. More careful examination of the omentum showed that the extravasated blood followed the ramifications of the blood vessels. The liver presented on its surface whitish nodules one to three millimeters in diameter. On section there seemed to be a great increase of fibrous tissue in this organ. The surface of the spleen was slightly roughened; pancreas apparently normal. Stomach dilated with gas. The intestines, large and small, showed no abnormality. Mesenteric glands enlarged. Kidneys quite normal in appearance. The transplated parathyroids were much changed in appearance and probably necrotic.

The remarkably sudden and very late appearance of the tetany in the above described dog is worthy of comment. This dog was aged. The dogs of this series were, with the exception of this one, quite young—estimated between one and two years of age.

Dog 11.—*February 10, 1908, Operation I:* Autotransplantation. The right superior glandula parathyroidea, rather small, was transplanted into the right rectus abdominis opposite the umbilicus.

February 27, 1908.—Dog has been well since Operation I. *Operation II:* The left superior glandula parathyroidea imbedded about 3 mm. below the upper pole of the thyroid, was transplanted through the fibers of the left rectus abdominis muscle on the posterior sheath of this muscle. Excision of entire left thyroid lobe. The dog is, presumably, reduced to the two transplanted parathyroid glands.

February 28, 1908.—No tremors.

February 29, 1908.—No tremors.

March 2, 1908.—No tremors. Dog seems fairly well.

March 30, 1908.—Dog has been, apparently, perfectly well since last note.

April 23, 1908.—Well. Has gained considerably in weight.

June 11, 1908, Operation III: The autoplants were very thoroughly searched for and only the left one found. This little body did not shimmer

through the peritonaeum as the transplanted bodies usually do but, projecting slightly, could be felt as a hard round nodule. On section it presented a kind of hilus of connective tissue, and at the cortex five minute brownish dots, separated from each other by a little fibrous tissue, were seen. These dots had the color which seems to characterize the transplanted thyroid and parathyroid glands which have been partially absorbed and invaded by connective tissue. I have already described this color as a little less red than the normal and as having a browner tinge with a suggestion of yellow.

The dog died of tetania parathyreopriva on the second (or third?) day after the third operation, the operation of functional test.

June 16, 1908.—The autoplant has been very carefully cut and all the sections preserved. They cover 15 slides. On each slide are 10 sections. Parathyroid tissue appears in none of the sections except those mounted on slides, Nos. 14 and 15, and in all of these (*vid.* Plate LXXXI).

This case is of particular interest proving, as it does, that a very minute piece of parathyroid gland may be sufficient to prevent all objective symptoms of hypoparathyroidism.

Of the macroscopically visible brownish-red dots of the successfully transplanted autograft, the largest proved on microscopic examination to be a fragment of thyroid gland; the smaller dots, barely to be seen with the naked eye, were portions of parathyroid gland, discrete, and separated from each other by strands of connective tissue. The largest of the parathyroid dots is the one depicted so beautifully by August Horn in Plate LXXX. The microscope revealed one or two minute areas of parathyroid tissue, too small to have been detected macroscopically. I regret that there is not time for the making of low-power drawings from these sections.

Isotransplantations

Dog 12.—*March 3, 1908, Operation I:* Transplantation of the right external and internal parathyroid glands from Dog 13 behind the right musculus rectus abdominis, just above the umbilicus. The right superior glandula parathyroidea from this dog was transplanted behind the right rectus of Dog 13. Right parathyroidectomy.

March 6, 1908.—Dog has been well since operation. Is naturally vicious and inclined to bite, hence difficult to examine. No tongue tremors.

March 10, 1908.—Has been well since last note. 2.30 p. m. *Operation II:* Completed the isotransplantation with Dog 13.

March 11, 1908.—Dog fairly well but so vicious that a careful examination was not made.

March 12, 1908.—9 a. m. Dog is very ill. General twitchings. Calcium lactate administered per stomach tube by Dr. Voegtlin. 4 p. m. Dog wonderfully better. There are no demonstrable twitchings.

March 16, 1908.—Has been treated daily by Dr. Voegtlin with calcium lactate. Dog still suffers from tetany, partially controlled, however, by the drug.

March 19, 1908.—Slight fibrillary tremors of the tongue still present but animal looks badly and refuses food.

March 21, 1908.—Little change in dog's condition. Still refuses food and has faint tongue tremors. No general tremors observed. Calcium lactate discontinued.

March 23, 1908.—Dog is dead. *Autopsy:* Entirely negative. A few drops of pus were found in the neck wound in mid-line under the skin. There was no trace of the parathyroid gland first transplanted. The second isoplant was necrotic.

Dog 13.—*March 3, 1908.*—Isotransplantation with Dog 12. Died of pneumonia two days after the final transplantation.

Dogs 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 and 28 were employed for isotransplantation experiments and in no instance with success. The dogs were taken in twos and the transplantations made as described for the pair Nos. 12 and 13. In no instance did privation symptoms appear after one-sided panthyroidectomy, but they always supervened on removal from the neck of the final parathyroid gland unless pneumonia carried off the dogs before the tetany had time to develop. The transplanted bodies were absorbed (usually leaving a trace of pigment at the site of the transplantation), or partially absorbed or simply necrotic in accord with the time elapsed after the transplantation. Calcium lactate, which was of such great assistance in several of the cases of autotransplantation, did not suffice to prolong, for more than a few days, the lives of the dogs wholly dependent upon the isografts. To Dog 12, developing tetany on the second day after the final isotransplantation, Dr. Voegtlin gave the calcium lactate for nine days, and with great improvement at first; but the animal died of tetany on the tenth day after its incidence.

Results (Winter of 1907-1908); Autotransplantation in or behind the Musculus Rectus Abdominis.—Of 18 autotransplantations in 12 dogs, 7 parathyroids were absorbed or necrotic (Dogs 3, 4, 5 and 10); five to seven lived and performed their function (Dogs 1, (2?), 7, 8, 9 and 11)—in Dog 2 for a very short time. In only one instance have we observed the survival of two grafts in one animal whether the transplantation was made in the thyroid, the spleen, or behind the rectus muscle. In the exceptional case the dog died on the ninth day of distemper, without symptoms of tetany. The autografts were very much smaller than when transplanted (*vid.* history of Dog 2).

In Dogs 7 and 11 the functional test was made. On removal of the sustaining autograft both died promptly of tetania parathyreopriva. In Dog 7, on the development of tetany, isografting was tried without success. Three isografts were placed. Dogs 8 and 9 still await the functional test. The former is sustained by the one autograft, transplanted February 6, 1908,

nine months ago. The latter has been reduced to one or other or both of his autografts since March 24, 1908, a period of seven months. Dog 8 has been myxoedematous for about eight months. The myxoedema seems to be hardly as pronounced now (November, 1908) as it was in June. Dog 9 is only slightly myxoedematous, at least as compared with Dog 8. Both have an eczema, dependent, probably, upon the thyroid privation. The falling out of hair has not been great. Neither dog on his return to the laboratory yesterday, November 3, 1908, manifested any of the signs of tetania parathyreopriva.

Isotransplantation in or behind the Musculus Rectus Abdominis.—Of 35 isotransplantations in 17 dogs with created deficiency (Dogs 7, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 and 28), 32 parathyroids were either absorbed or necrotic. Three were transplanted only 24 hours before the death of Dog 7. In this case isotransplantation (two grafts) was unsuccessfully resorted to 24 hours after the supervention of tetany. Deprived of all parathyroids except the one transplanted (an autograft), this dog lived in good health and spirits for 25 days, or until, at a final operation, the sustaining parathyroid was removed. There was in this dog, at times, a suggestion of hypoparathyroidism in a barely perceptible fibrillary tremor of the tongue and of the temporal muscles. On removal of the perfectly normal autograft (*vid.* Plate LXVIII) behind the rectus muscle, tetany developed within 24 hours. The following day the isografting was made, and without result, as stated (*vid.* history of Dog 7).

We have not as yet determined that one tissue or site is better than another for the transplantation, and do not even know that parathyroid glandules deprived of their blood supply in the course of operation or by experimentation might not, in some cases at least, survive if left undisturbed in the original situation in the neck. Inasmuch, however, as drainage is usually employed in thyroid lobectomy, and the drain usually carried to the precise situation of the parathyroids, to the deepest part of the wound, the better site for the transplantation of the glandules would be the opposite lobe of the thyroid gland.

Dr. W. L. Moss has very kindly tested the sera of a number of the dogs used in the experiments of isotransplantation. Reactions such as haemolysis and agglutination have not been obtained.

General Consideration

Isotransplantations without created deficiency were made into the thyroid gland and into the spleen and were uniformly unsuccessful. In the isotransplantations with created deficiency the grafts were, with few exceptions, placed behind the musculus rectus abdominis. In not a single instance in

our experience has an isograft lived. An autotransplantation entails necessarily, at least for a time, a deficiency of some degree. When the loss has been of two parathyroids only, as in one-sided panthyroidectomy, the grafts have invariably and promptly been absorbed (Dogs G, 3, 4, 5, 6 and 10). In other words, all the autotransplantations made at the first operation, at which the parathyroid glandules of one side only were excised have failed. In two instances (Dogs 7 and 8) the autograft transplanted at the first operation survived, but in each case a prolonged search for the glandules was made on both sides of the neck at this operation and so great a degree of parathyroid privation brought about that both dogs were ill with symptoms of hypoparathyroidism, presumably in consequence of the damage done to the circulation of the unexcised parathyroid bodies. Dog 7 was used for the functional test, and Dog 8 has been sustained nine months by one parathyroid glandule; he still lives and, except for myxoedema of a very pronounced type, seems in good health. In the two instances in which to the present time operation for the functional test has been made, a living autoplant has been found; in one of these it was the glandule transplanted at the second operation after complete thyroid privation (Dog 11); in the other, although the first, it was the only graft, and had been transplanted, as I have said (*vid.* history of Dog 7), after an operation so destructive to the parathyroid bodies as to cause tetany. In another of the successfully grafted dogs (Dog 1), which died during my summer vacation from cause other than tetany (autopsy by Dr. Voegtlin) it was probably the second and not the first graft that lived because the dog had very severe tetany after Operation II and would have died, we thought, if calcium lactate had not been given for several days. Such severe tetany we have seen only after complete parathyroid privation. A mild degree of tetany might conceivably be induced by anaesthetization and operation even though one parathyroid glandule were in a measure performing its function.

Two dogs, with myxoedema, await the functional test (8 and 9). In the case of Dog 9, alive and in good health except for thyroid deficiency (slight myxoedema) and sustained by one parathyroid body for the past seven and one-half months, it has not been determined which one of the two autografts survives. That he has slight symptoms of tetany following the second operation does not enable us to arrive at a conclusion, for with only one parathyroid glandule, and that a graft, such slight manifestations of hypoparathyroidism might not only appear after anaesthetization and operation but even persist, as our observations have taught us (Dogs 1, 7 and 8), for months.

In the light of the work of last winter, the restudy of the experiments of the year preceding strengthens the view that a considerable degree of defi-

ciency is essential to the success of the transplantations. For, of the autotransplantations into the thyroid gland and spleen, only those were successful in which as many as three glandules were excised. In the single case of autotransplantation into the thyroid gland in which the deficiency did not exceed one-half of the normal parathyroid supply (Dog G), both autografts, searched for not until three months and 20 days after their transplantation, were completely absorbed.

In only one instance of autotransplantation were all of the parathyroid bodies excised at one operation. In this case (Dog E) the four grafts were placed in the spleen. Death from tetany occurred on the third day after the operation. It is possible that calcium lactate might have rescued this dog from the list of failures; but the experiment was made in the year preceding this very important discovery of MacCallum and Voegtlin. That this salt was of great service to us in several cases, converting failure into success, there can be little doubt; and hence the query, is not success more likely to attend transplantations in animals such as rats, which may for a long time (weeks or even months), and in a state of chronic hypoparathyroidism, survive total loss of the parathyroid tissue, than in dogs which so commonly succumb before the end of the third day when the parathyroid privation is complete? For the success, then, of the transplantation of a completely extirpated organ the animal must be able to survive the total privation long enough for the grafts to acquire a circulation sufficient for, at least, a partial exercise of their function, unless chemical or other assistance be rendered. If death might be expected to follow complete privation of an organ furnishing an internal secretion, within say 24 hours, successful grafting might be impossible unless the period necessary for the "taking," or "catching" of the graft could be bridged over by the administration of doses of the missing gland, or of its chemical equivalent. It is significant that pneumonia occurred only in dogs whose parathyroid glandules had been totally excised.

The experiments have not been, in number, sufficient to establish as fact the necessity for creating a deficiency, but they lend strong support to this view. It is conceivable that the organism may sustain of transplanted parathyroid tissue only enough to prevent symptoms of privation or to preserve life and not an amount sufficient for the maintenance of perfect health. Is it then worth while in the human subject to transplant a parathyroid removed or injured in single thyroid lobectomy, which creates at most only a moderate degree of insufficiency and not enough perhaps to make probable the success of the grafting? What may be true of dogs need not be true of human beings. Nor can we know in a given case that the parathyroids are four in number, of equal size, and regularly distributed. The transplanta-

tion into the opposite lobe after thyroid lobectomy would require but a few moments, and should, in my opinion, not be neglected when a parathyroid body has been cut off from its blood supply. A glandule removed in the course of operation upon the second lobe (an accident which will rarely occur in the future) might, we believe, be more likely to survive transplantation than a glandule excised at the first operation, but only in case parathyroid privation, sustained for sufficient time, had been brought about by the original lobectomy.

Summary.

1. The autotransplantation of parathyroid glandules into the thyroid gland and behind the musculus rectus abdominis has been successful in 61 per cent of the cases in which a deficiency greater than one-half has been created.

2. In no instance has the autotransplantation succeeded without the creation of such deficiency.

3. Isotransplantation has been uniformly unsuccessful.

4. Parathyroid tissue transplanted in excess of what is urgently required by the organism has not lived.

5. One parathyroid autograft may suffice to maintain the animal in good health and spirits for many months and possibly for years.

6. Excised or deprived of their blood supply in the course of operation upon the human subject, parathyroid glands should, in the present state of our knowledge, be grafted, and probably into the thyroid gland.

7. Complete excision of the thyroid lobes in dogs may be well borne for a year or more. The myxoedema which usually has manifested itself within a few weeks has not increased after the first few months. May it subsequently diminish with the hypertrophy of accessory thyroids?

8. Parathyroid tissue is essential to the life of dogs, as has been conclusively proved by the result of excision of the sole, sustaining graft.

There may be found, perhaps, in our experiments, explanation of the fact observed by others (Enderlen, Payr) that, when transplanted, thyroid preserves its integrity less well than parathyroid tissue. In the instances recorded the amount of thyroid gland excised may have been insufficient to make possible the fullest success of the transplantation; and particularly so when we consider the extent of the hypertrophy of which the thyroid gland seems capable.

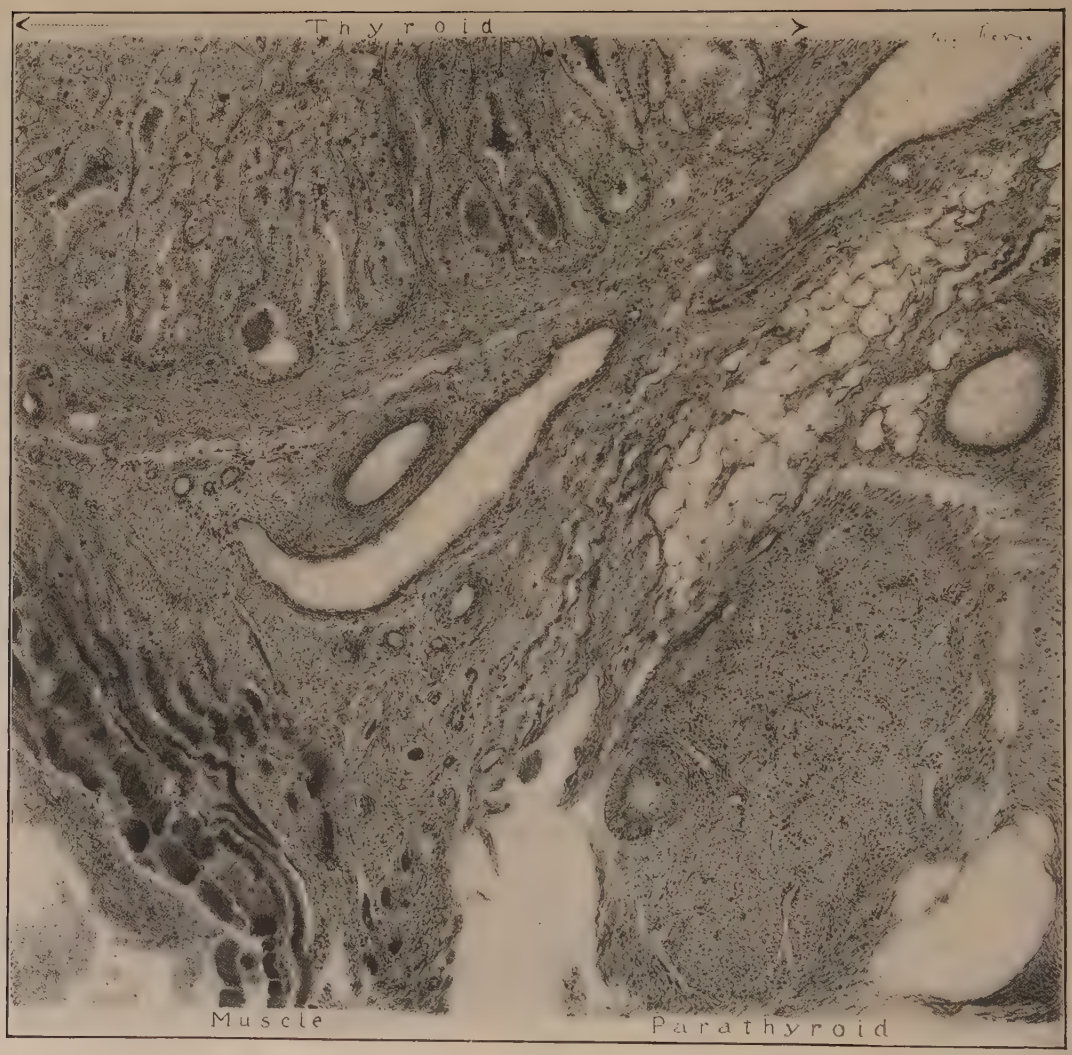
EXPLANATION OF PLATES

PLATE LXXX.—Enlarged 90/1. The autograft from Dog No. 11, excised at the operation of functional test, four months after its transplantation. Death from tetania parathyreopriva promptly followed its excision.

PLATE LXXXI.—Enlarged 125/1. The autograft from Dog No. 7, excised at the operation of functional test, one month after its transplantation. Death from tetany promptly followed its excision.

Muscle.
Thyroid
Parathyroid

PLATE LXXXI



EPITHELKÖRPERCHEN[1]

Es ist wichtig und schwierig genau zu bestimmen, wie viel von der Glandula thyreoidea in einem Falle der Basedow'schen Krankheit entfernt werden soll.

Diese Frage lässt eine eingehende Erwägung und Discussion zu.

Wir finden, dass wir allmählich mehr und mehr von der Glandula entfernen, sodass wir jetzt in vielen Fällen dieser Affection den grösseren Theil beider Lappen excidiren (in zwei oder mehreren Acten), ohne wie früher vielleicht ein Jahr oder länger zu warten, um das Resultat der Entfernung des einen Lappens zu beobachten. Ueber Folgendes aber kann kein Zweifel bestehen, nämlich: dass die Operation an dem ersten Lappen genau so ausgeführt werden sollte, als wenn die Operation an dem zweiten bestimmt in Aussicht genommen wäre. Deshalb muss ein Theil von jedem Lappen belassen werden, um die Epithelkörperchen zu Schützen. Ich bin überzeugt, dass es nicht immer möglich ist, das Leben der Epithelkörperchen dadurch zu bewahren, dass wir die hintere Kapsel oder irgend welchen Theil derselben zurücklassen.

In unseren Fällen von Basedow'scher Krankheit, in denjenigen, in welchen beide Lappen in der Weise entfernt wurden, welche gegenwärtig bei uns typisch geworden ist, sind vier Fälle von Hypoparathyreosis vorgekommen—zwei von diesen mit ausgesprochener Tetanie. Alle Symptome der Tetanie sind sofort nach der Darreichung von Calciumlactat geschwunden, nur ein Fall hat seinen Gebrauch länger als 10 Tage erfordert.

Diese Fälle von Tetanie, in welchen sicherlich nicht eine einzige Glandula parathyreoidea entfernt worden war, und in welchen die Circulation dieser Körperchen so sorgfältig wie möglich behütet war durch das Verfahren, welches ich Ultraligatur der Blutgefässe genannt habe, und durch das Zurücklassen einer Scheibe des Thyreoidgewebes am Hilus der Lappen, diese Fälle sage ich, stehen in einer interessanten Beziehung zu den Resultaten, die von uns bei der Transplantation von Epithelkörperchen bei Hunden erreicht wurden.

Es ist mehr als wahrscheinlich, dass die Epithelkörperchen auf der erst operirten Seite in diesen Fällen von Hypoparathyreosis abstarben und, in

[1] Remarks following papers by Dr. Theodor Kocher, Dr. Albert Kocher, and Dr. Klose on "Morbus Basedow." Vierzigster Congress der deutschen Gesellschaft für Chirurgie, Berlin, April 19, 1911.

Verhandl. d. deutsch. Gesellsch. f. Chir., Berlin, 1911, xl, Theil i, 45-47.

dem dies der Fall ist, dass diese Glandulæ parathyreodieæ auf den Zustand von Autografts (Transplantation) reducirt wurden.

Als Resultat unserer Experimente an Hunden hätten wir den Tod solcher Autografts prophezeien können, weil kein Mangel, oder besser kein ausreichender Mangel geschaffen worden war.

Wir sind schon seit 4 Jahren in der Lage, vorbehaltlich zu behaupten, dass folgendes Gesetz bei der Verpflanzung von Epithelkörperchen zu bestehen scheint, nämlich, dass, wenn nicht ein beträchtlicher Mangel an diesen Körperchen geschaffen ist, die Autografts nicht leben werden.

Das folgende interessante Experiment mag als typisch citirt werden:

Erste Operation.—Entfernung des Thyreoidlappens und beider rechten Epithelkörperchen. Transplantation einer der Glandulæ parathyreoideæ hinter der rechten Musculus rectus abdominis.

Zweite Operation.—Ungefähr vier Wochen später wurds die gleiche Procedur an der linken Seite vorgenommen. Leichte tetanische Symptome kamen sofort zum Vorschein. Diese verschwanden nach Darreichen von Calciumlactat. Ungefähr 4 Monate nach der zweiten Operation wurde der Hund von starkem Myxoedem befallen. Das Myxoedem verschwand indess einige Monate nach seinem Erscheinen.

Dritte Operation.—15 Monate nach der zweiten Operation, während der Hund sich ansehend in vollkommener Gesundheit befand, wurde nach den transplantirten Epithelkörperchen an beiden Seiten gesucht. Auf der rechten Seite, wie man hätte erwarten können, war keine Spur von dem verpflanzten Körperchen geblieben; an der linken Seite jedoch—der Seite, an welcher die Verpflanzung vorgenommen wurde nachdem ein totaler Parathyreoidmangel geschaffen worden war—wurde ein colossal hypertrophirter Graft entdeckt. Dieser wurde excidirt und nach ungefähr 6 Wochen starb der Hund an einer Cachexia parathyreopriva mit von Zeit zu Zeit acuten Erscheinungen von Tetanie.

Serienschnitte des excidirten Graft wurden gemacht, von denen alle sorgfältig untersucht wurden. Er bestand fast ausschliesslich aus Thyreoidgewebe. Die verpflanzte Parathyreoiddrüse war zu eine blossen Spur reducirt worden, nur ¼ mm. im Durchmesser. Dieses winzige Theilchen von Epithelkörperchen ist daher hinreichend gewesen, nicht nur um den Hund lebend, sondern ihn in einem Zustand von anscheinend guter Gesundheit zu erhalten. Eine sehr sorgfältige Autopsie, welche 3½ Stunden in Anspruch nahm, wurde durch Herrn Dr. W. G. MacCallum an diesem Hunde gemacht, welcher alle Theilchen entfernte, die dem blossen Auge sichtbar waren und welche möglicher Weise Parathyreoidgewebe sein dürften. Die mikroskopische Untersuchung dieser Körperchen war negativ, d. h. in Bezug auf Epithelkörperchen.

Wenn jedoch Parathyreoidgewebe gefunden worden wäre, so würde durch solchen Befund obiges Argument nicht abgeschwächt, denn der Tod des

Hundes war zweifellos der Entfernung des kleinen Ueberbleibsels des verpflanzten Körperchens zuzuschreiben.

Ich hätte sagen sollen, dass der erfolgreich verpflanzte Autograft in diesem Falle zur Zeit seiner Transplantation aus einer Glandula parathyreoidea plus einem möglichst dünnen Häutchen von Thyreoidgewebe bestand, und dass nur so viel von letzteren mitgenommen wurde als in dem Bestreben, die Epithelkörperchen zu excidiren ohne sie zu beschädigen, unvermeidlich war.

Die Vergrösserung des Thyreoidgewebes war vielleicht zwanzigfach.

Wir sind geneigt nach diesem und anderen Experimenten zu glauben, dass ein wesentlicher Mangel gewöhnlich geschaffen werden muss, um das Leben der Autografts zu garantiren. Beim Menschen, wo nach Excision eines Thyreoidlappens ein solcher Mangel nicht existirt, sind die Epithelkörperchen in besonderer Gefahr, wenn ihre Circulation gestört wird.

Da ein so winziges Stückchen, kaum mehr als eine Spur von Parathyreoid-Gewebe hinreichend sein mag, um das Leben eines Hundes zu erhalten, ist es wahrscheinlich, dass in den Fällen von Tetanie beim Menschen, welche sich nach doppelter Lobektomie entwickelt hat, die Epithelkörperchen auf der erst operirten Seite vollständig zu Grunde gegangen sind und, möglicher Weise auf der entgegengesetzten Seite in Folge der zweiten Operation auf den Zustand von Autografts reducirt, auf dieser letzteren Seite nicht abgestorben sind in Folge der Entfernung des ganzen Parathyreoidgewebes.

Die Entdeckung der Ursache für die, dem Anschein nach constante Atrophie der transplantirten Epithelkörperchen im Gegensatze zur Tendenz, auf die geringste Provocation der Glandula thyreoidea zu hypertrophiren, ist ein Schritt vorwärts, der von weitgehender Bedeutung sein dürfte.

REPORT OF A DOG MAINTAINED IN GOOD HEALTH BY A PARATHYROID AUTOGRAFT APPROXIMATELY ONE-FOURTH OF A MILLIMETRE IN DIAMETER, AND COMMENTS ON THE DEVELOPMENT OF THE OPERATION FOR GRAVES' DISEASE AS INFLUENCED BY THE RESULTS OF EXPERIMENTS ON ANIMALS [1]

PART I.

In a paper on the auto- and isotransplantation, in dogs, of the parathyroid glandules,[2] the histories of two of the dogs (Nos. 8 and 9) reported in the series of experiments were incomplete, the animals having been kept for further study. One of these dogs (No. 9) was observed for 15 months and was in good health until the performance of the final operation at which a parathyroid autograft too small to be visible [3] to the naked eye was removed (figures 1 and 2). The death of the dog from hypoparathyroidism occurred about three months after the removal of the tiny transplant which was only 0.25 of a millimetre in one diameter and little more than this in the other.

The history is as follows:

Dog 9.—*Operation I, February 6, 1908.*—Excision of the right thyroid lobe and both parathyroids of this side. The right inferior parathyroid was planted subperitonaeally behind the right musculus rectus abdominis.

Operation 2, March 24, 1908.—Excision of the left thyroid lobe with its two parathyroid glandules. The superior parathyroid, found much lower than usual and lying well exposed but somewhat within the substance of the thyroid, was sliced from the latter so as to include a very thin film of this gland, and immediately transplanted subperitonaeally behind the left rectus muscle.

The dog is now deprived of both thyroid glands. He is reduced to the two parathyroid autografts.

To transplant a film of thyroid gland with the parathyroid is a good precaution, because, in our experience, the tendency of the former is to hypertrophy when complete thyroidectomy has been done, and of the latter to

[1] Received for publication January 11, 1912. J. Exper. M., Lancaster, Pa., 1912, xv, 205-215. (Reprinted.)

[2] Jour. Exper. Med., 1909, xi, 175.

[3] Fortunately a delicate film of thyroid tissue had been transplanted with the parathyroid glandule. Were it not for the occurrence of the hypertrophy of the former, in which the latter was embedded, it would hardly have been possible to identify this minute, quite invisible parathyroid autograft

disappear, and it might be, as it would have been in this case, impossible to discover the transplanted parathyroid except for the presence of the hypertrophied thyroid tissue in which the tiny transplant was embedded.

March 25th.—Dog seems unaffected by the second operation.

March 26th.—Is as lively as ever, but has faint tongue tremors.

March 27th.—Tongue tremor seen only occasionally.

March 30th.—Temporal as well as tongue tremors; the latter more marked than at last note. Dog not so well as heretofore.

April 1st.—Better. No sign of parathyroid privation.

April 4th.—In usual good spirits. No tremors.

May 9th.—Seems in perfect health. No tremors. Is gaining in weight.

May 23d.—Has become abnormally stout. Myxoedema (?).

June 11th.—Has greatly increased in size. Hair is thinner. Skin seems thickened. Is quite surely myxoedematous. No evidence of hypoparathyroidism. Transferred to Drs. Voegtlin and Strouse for observation and experimentation during the summer.

November 5th.—Dog has been returned to me by Drs. Voegtlin and Strouse. He seems well, but is not so active and demonstrative as formerly. The myxoedema is much less. There is no evidence of hypoparathyreosis.

February 24, 1909.—Dog has been quite well since the last note. There is no distinguishable myxoedema, although the hair is still thinner than normally.

Operation 3. Functional Test. Search for the Transplanted Parathyroids. February 25, 1909.—Assisted by Drs. Gatch and Emmert. Ether. Through a mid-line incision from about 3 cm. below the ensiform cartilage to the same distance below the umbilicus, a careful scrutiny of the peritonaeal surface on both sides behind the recti muscles was made. The findings on the right side were negative, as we had expected, for this was the side on which the first parathyroid transplantation was made—a transplantation for which no deficiency had been created. But on the left side, very near the mid-line scar, and shimmering through a locally thickened, almost opaque peritonaeum, was a dark spheroidal body about 7 mm. in diameter. In excising this nodule, which was done with the greatest care, and in order that none of the transplant might remain, some of the surrounding tissue was included. Examining the excised piece, I feared that the greatly hypertrophied graft had been shaved too close behind and accordingly cut out a second piece.[4]

I was surprised to find that the graft had in such remarkable degree increased in size and hoped that at last we might have evidence that the parathyroid glandule was capable of hypertrophy. The color of the trans-

[4] Both of these pieces were hardened in Zenker's fluid, stained *in toto* and cut in serial sections by an expert technician. All the sections were preserved, and all those of the main piece mounted in proper order. As the sections of the underlying second piece contained no parathyroid tissue, only every tenth section was mounted. Dr. W. G. MacCallum studied all the mounted sections with the result given by him further on.

plant was the characteristic reddish brown with a slight suggestion of yellow. In consistence, it was hard as if invaded by connective tissue. Its connection with the surrounding tissues, connective and muscular, was intimate, as if considerable reaction had been excited by its presence. It is, of course, possible that on the other side (the right) there may be a remnant of the parathyroid transplanted there at the first operation, but, if so, it is too small to be seen by the naked eye.

March 8, 1909.—The dog seems to be very little affected by the removal of the graft.

March 10th.—Is still, apparently, quite as well as before the last operation, although occasionally there is a fairly definite fibrillar tremor of the tongue.

March 20th.—Dog has gradually failed in vigor since the last note. He is becoming myxoedematous again.

This is interesting as indicating that the disappearance of the rather excessive myxoedema which occurred at the second operation, after the removal of the remaining thyroid lobe, was due, at least in considerable measure, to the hypertrophy of the delicate and very small thyroid film included in the parathyroid graft.

April 2d.—Dog is exhibited before the Interurban Medical Society at one of my clinics. Tongue and temporal tremors are pronounced. The Trousseau phenomenon is readily obtainable on both sides by pressure over the femoral arteries. He is becoming definitely weaker although still lively and demonstrative.

May 1st.—Observed each day, since the previous note, by Dr. Gatch or myself. The dog has been steadily failing and is now quite weak. The tremors have become general and are almost constantly present. He sniffles in the manner characteristic of extreme hypoparathyroidism, and the upper lip, on handling, draws up as in snarling, on one or both sides.

May 15th.—Dog is so nearly dead that I asked Dr. William G. MacCallum to see him with a view to killing him at once to insure having fresh tissues for the autopsy. We finally decided to postpone this and to watch him carefully.

May 24th.—Having almost expired, the dog is killed under an anaesthetic.

Dr. MacCallum performed the autopsy with exceeding care. I am greatly indebted to him for the following admirable report:

May 24, 1909. *Autopsy* on Dr. Halsted's dog (Dog 9) in which a parathyroid had been transplanted (more than a year ago) and later removed.

Dog is emaciated. The hair is irregular—has dropped out or become thin in places. Anaesthetized and bled to death from femoral. Dissection of neck as shown in Plate LXXXIII.

Sutures and ligatures healed imperfectly. There was absolutely no solid body of tissue in the region of the superficial wound. Muscles carefully stripped apart and each mass of the tissue labeled and preserved. Larynx separated into various parts, trachea examined throughout. Tongue removed and sectioned. Hyoid region carefully

studied as well as the original thyroid regions; also the lateral and median portions of the neck throughout. Four or five small masses, apparently hypertrophied accessory thyroids, found near the trachea below the cricoid cartilage. No definite structures of this sort found elsewhere. No obvious parathyroid remains. Careful search made in the substernal tissues and in the tissues about the pericardium and the arch of the aorta and pulmonary vessels; no further thyroid found. Lungs and heart normal. No abnormality seen in the liver, kidneys, pancreas, adrenals, or in the intestinal tract.

Testes seem small—one sectioned appeared fibrous.

Hypophysis showed no macroscopical abnormality. Brain externally normal. Wound in abdomen behind rectus searched with negative result.

Microscopical Examination of the Tissue Removed.—(*A*) is a mass of hypertrophied thyroid tissue. This is surrounded by a dense fibrous capsule and is composed of alveoli empty of colloid or containing only traces of it. They are extremely irregular in outline, and some are so small as to show no lumen whatever. They are lined by high columnar epithelium. In other words, they present the appearance described by Dr. Halsted as arising in the course of hypertrophy of the thyroid.

(*B*) is a small lymph-gland.

(*C*) is a large lymph-gland. It shows no particular lesion.

(*D*) is a mass of hypertrophied thyroid showing the same characteristics as (*A*) with beautiful, irregular alveoli and containing a glassy looking, ragged colloid.

(*E*) is a mass of thyroid tissue. The alveoli are not nearly so irregular as in the case of (*A*) and (*D*) and contain a good deal more pink-staining colloid material. The epithelium is not quite so high and is more smoothly arranged. There is no parathyroid tissue to be observed.

(*F*) is a mass of thyroid tissue containing very large, irregular alveoli with columnar epithelium and relatively little colloid. At one corner there is a solid mass of cells which do not closely resemble any normal tissue, but are in all probability thyroid cells, although they form no alveoli. They have not the appearance of parathyroid tissue.

(*G*) is a rounded mass of thyroid tissue showing the same general characteristics as (*F*). Its alveoli contain a good deal of rather ragged colloid material. There is a sympathetic nerve ganglion nearby and the vascular supply seems to be very good.

(*H*), the nodule on the surface of the heart inside the pericardium, is also thyroid tissue. It is surrounded by a thick capsule and composed of very irregular alveoli. Many of these contain granular colloid, while others are practically solid and have no lumen.

(*I*) is a lymph-gland situated along the brachiocephalic artery.

(*J*) is a hemolymph-gland situated near the first rib on the left side.

(*K*) is a lymph-gland near the first rib on the right side.

(*L*) is a small lymph-gland.

(*M*) is the tissue just under the arch of the aorta. It is composed chiefly of fat with many nerves and some ganglia. In connection with one of these ganglion-like masses there is a small, glandular-like structure which is not thyroid and not parathyroid, but which is probably a mass of chromaffine tissue. It is composed of acini in which the cells have a ragged protoplasm. They do not leave a very distinct lumen; their rounded vesicular nuclei lie near the base of the cell. Other masses of a similar character are scattered in the tissue.

Another section marked retrosternal lymph-gland shows a normal lymph-gland surrounded by fat.

"The hypophysis shows rather distinct alterations. The pars nervosa is practically surrounded in the section by the pars intermedia which is perhaps slightly thickened and contains one or two alveoli full of colloid. The pars anterior is in part very deeply stained with eosin, but one portion, and that the major part, is sharply marked off from this eosin-stained tissue by its lilac color. It contains only a few of the bright staining cells, but for the most part is made up of swollen, faintly granular, palely stained cells. These resemble very closely the section obtained by Dr. Homans after in-

jecting pilocarpin. The cleft in the glandular part of the hypophysis is here seen to open into the subarachnoid space.

The adrenals show no abnormality.
The spleen seems normal.

"The testicle shows absolutely no sign of spermatogenesis. The cells which line the tubules are in single rows and are not in process of mitosis. They are drawn out into long filaments which are entangled in the wide lumen of the tubules, but there is no sign of a spermatozoön. The whole testis has an atrophied appearance and looks spongy. The interstitial cells of Leydig are inconspicuous. Some are seen, at least, which lie in their position, which are taken to be interstitial cells. They are large and very much vacuolated as if containing large globules of fat. It gives one the impression that these cells, too, which are supposed to preside over secondary sexual characters, are markedly influenced by the loss of the thyroid, although their changes are by no means so striking as the changes in the spermatogenic tissue. They are still in abundance even though a rather degenerated appearance of their protoplasm suggests that they have undergone some change. At best, however, the interstitial cells have a very irregular protoplasm. It seems that perhaps the most interesting result of this microscopical study lies in the determination of the complete loss of spermatogenic function of the testicle.

No trace of parathyroid tissue is to be found anywhere.
The pancreas shows no abnormality.
The kidney shows no special abnormality except for the almost complete shriveling up of some of the glomeruli.
The liver shows no abnormality.
There is quite abundant thymus tissue. In the thymus there are some cysts, one quite large, one lined by ciliated epithelium. Such ciliated cavities of small size are found quite frequently through the tissue. I do not see any Hassall's bodies unless these might represent them. The thymus is not in the acme of its development but has undergone a certain amount of atrophy.

"The sections of the little body removed at the third operation at the site of the transplanted parathyroid gland are composed chiefly of thyroid tissue This tissue closely resembles the human thyroid in cases of exophthalmic goitre, so large are the alveoli and so great the amount of convolution. A small mass of parathyroid tissue is found, but only on a limited number of slides and right at the edge of the sections. It first makes its appearance in the middle of slide 2; extends, then, through all the sections of slide 3, and disappears finally in the last section of slide 4—that is, extends through 32 sections. These sections are not perfectly uniform in thickness but will probably average 10 to 15 microns. This would make the mass of parathyroid tissue measure from 320 to 480 microns in thickness, that is, less than $\frac{1}{2}$ mm. Transversely, the mass measures not more than $\frac{1}{4}$ mm. measured by a stage micrometer. It is almost inconceivable that so small a mass could have been so sufficient to carry on the function of the gland. It is enclosed in a dense fibrous tissue which is abundantly vascular and has the usual structure of a parathyroid gland. It shows no degenerative changes, but at one point there are tubular structures embedded in the gland which are rather difficult to interpret. These are lined by flattened epithelium and are

really not directly in contact with the gland tissue but are surrounded by a hyaline connective tissue. The cells of the parathyroid and the nuclei are pretty well preserved. The thyroid tissue round about is composed of alveoli of the most varying size, lined with high, columnar epithelium and extremely irregular in outline, so that folds are thrown up into the lumen of each alveolus. Some of the alveoli are very small and contain no colloid, while the larger ones are filled with homogeneous colloid (Plate LXXXII, 1 and 2)."

It is interesting to note how slowly the tetany developed and for how long a time the animal lived after the removal of the almost microscopic transplant. The final operation was performed the 25th of February and the first definite sign of parathyroid privation was not observed until March 10th, 14 days later. This is in great contrast to the prompt appearance of privation symptoms, one or two or three days after the simultaneous removal in dogs of all the parathyroid bodies, but in accord with observations made by me in 1887 and 1888, that when these glands are removed two at a time with a considerable interval between the operations, the outbreak of tetanic symptoms may be delayed by several days. Dog 9 lived three months absolutely without parathyroid tissue, so far, at least, as it was possible with the most painstaking search, to determine this fact. Whether or not there was somewhere in the animal's body a particle of parathyroid tissue remaining at the time of its death will, of course, never be known, but it is quite certain that the removal of an "epithelial body" so small as to be practically invisible produced the almost inconceivable effect described, namely, death from tetany in an animal whose condition prior to the removal of the few cells had been excellent.

The dog's organism had, it seems, in some way accommodated itself to the loss of all of its parathyroid tissue except the quite invisible remnant in the graft; so that on the removal of this minute fragment, the impression produced was neither so immediate nor so profound as it is after the excision of these glandules in the animal unprepared for their loss.

In confirmation of the story of Dog 9 is that of another dog (No. 8) operated upon three times in precisely the same way, on approximately the same dates, and affected in an almost identical manner. The differences observed in the two dogs tend to strengthen rather than weaken the argument which has been advanced.

In Dog 8 both thyroids and all the parathyroids had been removed in two operations, and one parathyroid transplanted extraperitonaeally at each of these. But the myxoedema in Dog 8 became excessive after the removal of the second thyroid lobe (second operation) and remained so to the end of its life a year later. Furthermore, mild symptoms of parathyroid privation

persisted throughout, and finally, prolonged and thorough search (third operation) for the parathyroid autograft was negative in result although the sites of the transplantation of these bodies had been accurately recorded. Unfortunately, the nonresistant myxoedematous tissues of this dog became infected in the course of the prolonged third operation and death from peritonitis followed so quickly that there was not time for the development of lethal tetany. The slight previous symptoms of hypoparathyroidism became, however, definitely intensified. At the autopsy no accessory thyroid could be found and not a trace of the transplanted epithelial bodies. The persistence of the myxoedema in this case is to be explained by the facts that the parathyroid glandule transplanted at the second operation was devoid of thyroid film, and that accessory thyroid glands were wanting. That the search for the parathyroid transplants in Dog 8 should have been negative the findings in Dog 9 explain; for had it not been for the hypertrophied thyroid film in this dog it would probably have been impossible, as I have said, to discover the remnant of the parathyroid graft.

PART II

Although thousands of operations have been performed, the world over, for the cure of Graves' disease, we are not as yet in a position to state how much of the thyroid gland should be removed in any given case. Some of the severest cases have been sufficiently cured by the removal of one lobe, and in some of the mildest the excision, almost total, of both lobes has been necessary to bring about a cure or a satisfactory condition. But we find ourselves gradually coming to the conclusion that more than one lobe of the thyroid gland must be removed in certain cases of Graves' disease, so that at present in quite a considerable number of these cases we excise the greater portion of both lobes (usually in two acts)[5] provided the excision of one lobe has not been attended with the desired effect, without waiting, as formerly, one or more years to observe the result of the removal of the single lobe.

In two of my cases, in which three and four arteries respectively had been tied and both lobes almost totally excised, severe symptoms of thyroid intoxication persisted; and only after removal of all but a fragment of one lobe was satisfactory relief obtained.

One case died in the convulsions of a thyroid toxaemia, one and a half years after the final of four operations at which three thyroid arteries, one lobe, and two-thirds of the other had been excised.

[5] Occasionally both lobes are excised at one operation.

This accords with the observation, recorded above, that the hypertrophy of hardly more than a film of transplanted gland plus, perhaps, the hypertrophy of minute accessory thyroids sufficed in the dog to cause the disappearance of myxoedema.

That a very small, seemingly quite negligible part of a thyroid gland with disordered function might be responsible for severe toxic symptoms is quite as comprehensible as that the removal of the little thyroid autograft (Dog 9) should account for the reappearance of myxoedema.

The surgeon must, therefore, not despair of being able to effect a cure, approximate or complete, so long as any portion of the thyroid gland, functioning so riotously, remains.

I believe that, in the present state of our knowledge, the operation upon the first lobe should be conducted just as if the operation on the second lobe were definitely contemplated. Therefore, a small portion of each lobe must probably be left in order to preserve with sufficient certainty the parathyroid glandules. In 20 (?) of our cases of Graves' disease in which both lobes have been removed in this manner, which is with us at present typical, four cases of hypoparathyreosis have occurred, two of these with pronounced tetany. The symptoms of tetany disappeared promptly on administration of calcium lactate, only one case requiring the giving of this drug for a period longer than 10 days. These cases of hypoparathyroidism in which certainly not a single parathyroid gland was removed and in which the circulation of these epithelial bodies was protected with the greatest care by the preservation of a slice of thyroid tissue at the hilus of the lobe, these cases, I say, stand in interesting relation to the results which we have obtained in transplantation of the parathyroid glandules in dogs. It is more than likely that the epithelial bodies died on the side first operated upon in these cases of hypoparathyreosis in the human subject, and that, if this is the case, these parathyroid glands had been reduced to the condition of autografts. This inference is defendable for the reason that in the dog a tiny fragment of parathyroid tissue is sufficient to preserve the health of the animal and that it is improbable that tetany would have supervened in our patients at the second operation if one or both or considerable portions of either of the parathyroid glands had survived on the side first operated upon. As a result of our experiments on dogs, we might have prophesied the death of such autografts inasmuch as an inconsiderable or insufficient deficiency had been brought about. For the past five years we have been in a position to state, provisionally, that in the transplantation of the parathyroid glandules, *the following law seems to exist; namely, that unless considerable deficiency in parathyroid tissue has been created, the autografts do not live.* So, too, in the human subject in which first one and then, later, the second thyroid

lobe is removed, the " epithelial bodies " if reduced to the condition of autografts would be more likely to die on the side first operated upon than on the side of the second operation. Conversely, the epithelial bodies on the second side would be more likely to live than those on the first because, by the loss of the glandule as a result of the first operation a sufficient deficiency had been created to insure, as a rule, the life of one or perhaps both of those upon the other side, however completely their circulation might have been cut off. It is important to state that all of the cases in which postoperative tetany developed were so highly toxic before operation that the ligation of two or more thyroid arteries in from one to three acts was made as a preliminary to the lobectomies. The ligation of these arteries, plus the thyroidectomy and plus the connective tissue formation resulting from three to five operations may have been a decisive factor in the determination of the tetany. If this is true, it would be an argument, other things being equal, in favor of omitting the preliminary ligation and excising at the first operation as much of both lobes as seemed likely to be indicated. But I am, and alas, with good reason, decidedly opposed to the view that the intensified toxaemia which occurs after lobectomy in cases of Graves' disease is due solely to the overactivity of the lobe which remains and that, consequently, in the desperate cases, the safer procedure, so far as mortality is concerned, should be the removal of both lobes at one operation. It would probably be out of place to discuss this matter more fully in this *Journal,* hence, it must suffice, at this time, to say that I feel justified in firmly endorsing the view of Kocher that we have a great safeguard in the preliminary ligation of the arteries in the serious cases of exophthalmic goitre. Quite as important as the improvement in the patient's condition, which usually, for a time at least, follows the ligation of one or more thyroid vessels and enables the operator to proceed with greater safety to the excision of a lobe, is, in my opinion, the indication which the operation of ligation gives the surgeon of the relative intensity of the reaction likely to occur after lobectomy in the particular case.

EXPLANATION OF PLATES

Plate LXXXII

1.—Section of the entire graft (five diameters) removed from Dog 9, 14 months after the transplantation.

2. The parathyroid and surrounding tissue from figure 1 enlarged (100 diameters).

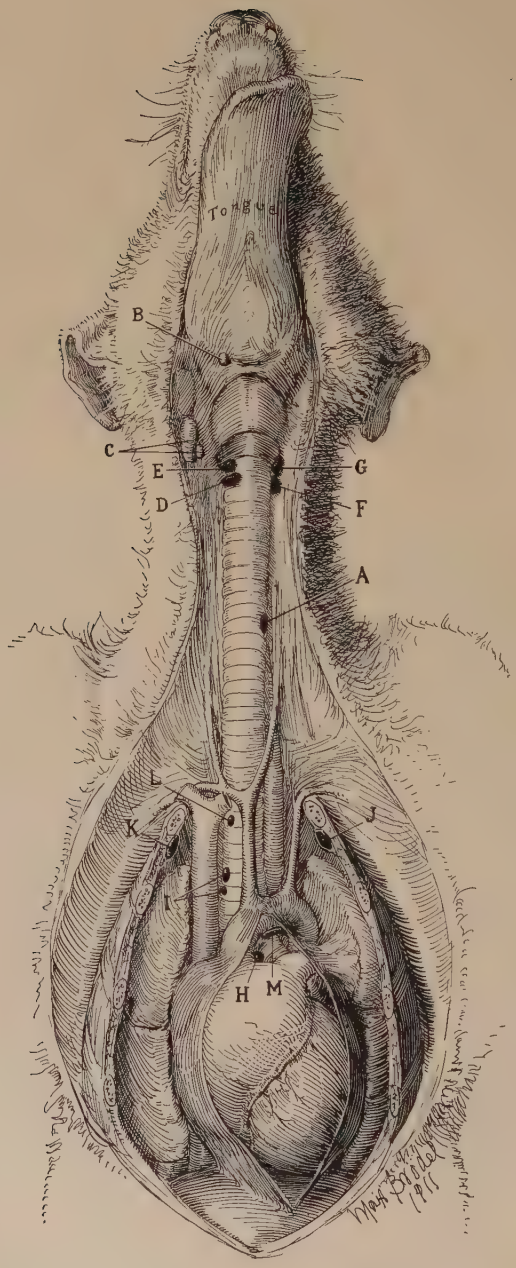
Plate LXXXIII

Diagrammatic representation of the findings at autopsy in Dog 9.

1.

2

PLATE LXXXIII



RECONSIDERATION OF THE QUESTION OF EXPERIMENTAL HYPERTROPHY OF THE THYROID GLAND, AND THE EFFECT OF EXCISION OF THIS ORGAN UPON OTHER OF THE DUCTLESS GLANDS[1]

The space allotted is so short that I cannot do more than indicate in merest outline a few of the problems which have presented themselves in the course of our study in animals and the human subject of the functions of some of the glands of internal secretion.

Twenty-five years ago, in the course of experiments upon the dog, undertaken chiefly with a view of determining the cause of death after operations upon the thyroid gland, I was surprised to find that excisions or transplantations or simple manipulations of the thyroid lobe were, after a time and almost invariably, followed by increase in the size of the remaining portions of the gland, wherever situated.

Examination of the hypertrophied tissue revealed the most unexpected and astonishing histological picture, a structure so different from the normal gland that not one of the several eminent pathologists in this country and abroad, to whom I showed the sections, was able to identify it. The histological changes which resemble those found in exophthalmic goitre are now so well known as not to require mention at this time. With few exceptions this hypertrophic picture made its appearance within 22 days after operation of any kind upon the thyroid gland, and even in its most advanced type was observed so late as 95 days after operation.

My observations have been confirmed by many, most carefully and convincingly by Marine, and the hypertrophy has generally been regarded as compensatory.

In my original article I expressed the view that possibly some form of autointoxication might account for the hypertrophic changes, and for some years have thought that the hyperplasia of the remaining thyroid tissue

[1] Presented at the Society for Experimental Biology and Medicine, New York, February 19, 1913.

Read by invitation before the Association of American Physicians at the Ninth Triennial Session of the Congress of American Physicians and Surgeons, Washington, D. C., May 7, 1913.

(Abstr.) Proc. Soc. Exper. Biol. and Med., N. Y., 1912-1913, x, 111-113.

Also: Tr. Ass. Am. Physicians, Phila., 1913, xxviii, 127-135. (Reprinted.)

Also: Am. J. M. Sc., Phila., 1914, n. s., cxlvii, 56-62. (Reprinted.)

which has followed excision of a portion of the gland might possibly be due to infection of the wound, and for the following reasons:

1. The increase in the size of the remaining thyroids and the degree of hyperplasia as indicated by the histological picture seemed to bear no relation to the amount removed. The excision of so little as one-fourth of one lobe might be followed by great increase in the size of both lobes, and by the histological changes which characterize hyperplasia.

2. In 1888 I found that hypertrophy of the thyroid glands of dogs occurred after the injection of several cubic centimetres of a bouillon culture of *Staphylococcus aureus* into the peritonaeal cavity, and also when a mild form of peritonitis had been produced in these animals—a peritonitis which was not rapidly fatal.

3. Experiments conducted in 1906 and 1907, in the Hunterian Laboratory, seemed to indicate that for the successful transplantation of a parathyroid glandule a considerable deficiency must be created.

4. Twice in the course of the past five years I have had opportunity to examine the remaining lobe of the thyroid gland after excision of the other in dogs whose wounds had healed throughout without suppuration, and have noted that there was no hyperplasia of the former.

5. From a restudy of the report of my experiments on extirpation of the thyroid gland made in 1888, I find that for the major part of the experiments the wounds of the dogs were left open, and that after 22 days, with few exceptions, there was hypertrophy, macroscopic and microscopic, of the remaining gland in the animals whose wounds were permitted to heal by granulation, whereas when the wound healed *per primam* the hyperplasia of the remaining thyroid tissue developed perhaps less regularly and not to the same extent.

6. Manifestations of hyperthyroidism may develop promptly after tonsillitis, appendicitis, pneumonia, typhoid fever, and other infections.

In October, 1912, I proposed to Dr. Hunnicutt that he undertake a series of experiments with a view of determining the matter definitely. Observing aseptic precautions in the strictest manner, Dr. Hunnicutt has made a large number of experiments on dogs, and we are able to report that in none of the thyroids thus far examined has there been the slightest evidence of hyperplasia. The average time allowed to elapse between the removal of the first and second lobes was 55 days, the shortest interval being 30 and the longest 81 days.

That, nevertheless, there is such a thing as true compensatory hyperplasia of the thyroid gland is proved, I think, by my experiments in transplantation of the parathyroid glandules; which were conducted with the strictest aseptic precautions. Thus when both thyroid lobes and the four parathyroid

glandules have been removed and only a film of thyroid transplanted with one parathyroid body, this film hypertrophies enormously, and on microscopic examination displays the typical changes of extreme hyperplasia. In one instance in which the graft was examined 15 months after operation, the transplanted film had become as large as a good-sized pea.

If it should become a definitely established fact that true compensatory hyperplasia of the thyroid occurs only after the removal of a considerable part of this gland, and that infection or diet or some unknown factor has been responsible for most of the hypertrophies hitherto recorded, investigations are then made possible which could not be undertaken to any purpose if hyperplasia might be expected to follow operative interference of almost any sort upon the thyroid lobe.[2]

Although expecting that in wounds which healed by first intention hyperplasia might not develop after excision of small portions of one thyroid lobe, it surprised me to find from this year's experiments that so much as one and a half lobes may be removed without appreciable effect upon the remainder of the gland, and for the moment my interest in the search for an explanation of the entire absence of any sign of hypertrophy in the experiments of the past winter is as keen as it was years ago to explain the invariable hypertrophy which followed almost any sort of operative interference with the glandula thyroidea. Dr. Marine, replying a few days ago from Vienna to a letter in which I asked for his opinion, writes: "I am anxious to know whether you used iodine in the sterilization of the skin. This, as you know, inhibits to a marked degree compensatory hyperplasia following partial removal just as it does any physiological outgrowth. After trying all sorts of ways to check your 1888-1889 results we always got exactly what you then reported, and I shall have to have very conclusive evidence before being convinced that your results obtained in 1888 could be explained on the bases of wound infection." . . . . "You have doubtless controlled the diet as a factor in compensatory hyperplasia."

In most of our experiments the skin has been disinfected with iodine, but in numerous instances it was not.

In 1888 our dogs were fed chiefly on raw meat, whereas during the past year their food has consisted almost exclusively of corn bread and cooked lungs of beeves. From the observations of David Marine, Reid Hunt, Chalmers Watson and others, which bear on this subject, it seems not unlikely that in the diet may be found the solution of the problem.

[2] In five unvaccinated dogs operated upon without precautions and whose wounds were left open, there was, greatly to my surprise, not the slightest indication of hypertrophy of the remaining lobe after 30 days.

Should we find that, as a rule, three-fourths or more of the entire gland must be removed before the hyperplastic changes develop, this will be additional evidence to strengthen the belief that the thyroid gland is normally in a state of relative inactivity, and that it is an organ with great reserve power, capable of responding promptly, almost instantly, to certain stimuli.

Of particular interest in this connection are the experiments, just published, of Dr. Reich and Professor Blauel, of Vienna. They find that in rats, whose thyroids normally have cuboidal epithelium, compression of the trachea is followed by flattening of this epithelium, to an extreme degree. If the oxygen-deprivation induced by the obturation of the trachea should prove to be the cause of the regressive or hypotrophic changes, might we expect to find that the colloid goitres which produce a great degree of tracheal stenosis are less likely to become Basedowified than those which are not accompanied by symptoms of suffocation?

Among the queries which present themselves at the moment are the following:

1. Must a deficiency be created for the successful grafting of ductless glands? Biedl claims to have successfully transplanted two parathyroid homografts in a dog which had not been deprived of any of its parathyroids. To justify his position, he states that all depends upon how long a transplant must live in order to be called a successful one. It seems to be an unchallenged proposition that a transplant cannot live unless it is functioning. But what is meant by functioning? Are tissues growing *in vitro* performing a function? Are the spirals of elastic tissue which we wind about the aorta functioning for a time? For about two months these spiral bands seem to live and continue to constrict the artery, but in six months they are almost absorbed.

2. What proportion of both thyroid lobes is it necessary to remove in order to produce hyperplasia of the remainder? The removal of one and one-half lobes has not been followed by hypertrophy in our experiments of this year.

3. Can a graft live without showing the hyperplastic picture? In other words, will a graft be absorbed unless the deficiency created is so great that hyperplasia must develop? Should the fact that a surviving graft retains the normal structure be taken as evidence that it will be absorbed (that its life will be short of duration)? And could a graft with such dubious existence be stimulated to hypertrophy and to prolonged life by the introduction of conditions which might demand of the thyroid increased function?

If we are still in doubt as to the cause of the hypertrophy of the thyroid glands in our experiments of 25 years ago, and are unable to explain its

entire absence in our dogs of this past winter, after making scores of experiments to determine the effect of the removal of part of one gland on the remainder of the same organ, how infinitely greater are the difficulties incident to the explanation of the effects upon ductless glands other than the one surgically attacked.

Hypertrophy or enlargement of the hypophysis, for example, described by many authors as following thyroidectomy, has been observed in various parts of the gland: in the anterior lobe, in the pars intermedia, and even in the pars nervosa. There are conflicting views as to the changes which take place both as to situation and histological detail. By most investigators the formation of colloid is emphasized, and this has been interpreted by several as signifying a taking on by the hypophysis of the function of the thyroid; the colloid in the former replacing this substance lost in consequence of the thyroidectomy.

But when experimental hyperplasia of the thyroid takes place, the colloid, instead of being increased in the remaining hypertrophied lobe, is diminished or disappears altogether; and this being the case, it would seem strange that, after thyroidectomy, it should appear in compensating fashion in the pituitary gland. We think of the normal thyroid, with its large follicles filled with colloid, relatively dense and deeply staining, as being in a state of comparative inactivity or rest; and the histological changes which have been stimulated in one gland by the removal of another have usually been considered as representing hyperactivity of this gland. But to me it appears unlikely that the colloid in the hypophysis which it is assumed makes its appearance in response to thyroid deficiency should signify hyperactivity of that organ, when the same colloid in the thyroid is found in abundance only in the comparatively inactive period of this gland.

It seems to be a natural inference that the loss of one gland of internal secretion should lead to the compensatory hypertrophy of another; and should colloid make its appearance in the eagerly observed unaccustomed places after the removal of a gland which normally is composed chiefly of colloid, the evidence for the compensatory nature of the change would seem to be so complete as to make further substantiation unnecessary. But I am quite sure that the evidence for the current view is not conclusive.

Is it not more probable that the elimination of the function of the thyroid may lessen, directly or indirectly, the demands on other of the ductless glands, and that the colloid changes noted in the hypophysis and parathyroids after thyroidectomy may signify hypo- and not hyperactivity of these organs?

A contribution by Kummer,[3] of Geneva, to the study of postoperative tetany, presented at the Twenty-fifth Session of the Congrés Française de Chirurgie, Paris, 1912, is worthy of unusual consideration. A woman, completely deprived of the cervical thyroids and parathyroids, was kept alive for two years.

The autopsy was made by Professor Askanzy,[4] who found in the hypophysis changes which seem to be identical with those described by William G. MacCallum[5] as having been present in the hypophysis of one of my dogs 15 months after the removal of both thyroid lobes and of the four parathyroids. This dog, kept alive for this long period by a parathyroid autograft only 14 mm. in diameter, died of tetany on the removal of the transplant.

Rarely again should there be an opportunity to study on the human subject the effects, after two years, of the complete removal of the thyroid and parathyroid glands.

We have never observed hypertrophy of the transplanted parathyroids even when total thyroidectomy and total parathyroidectomy have been done. I am not prepared, at present, to report the results of operations to determine the effect, if any, upon the thyroid of excision of the parathyroids; but I am not quite willing to accept as proved the observations of others who claim that after thyroid lobectomy the parathyroids are stimulated to compensatory hypertrophy, forming follicles containing colloid. *Why should the excision of an amount of thyroid insufficient to bring about thyroid hyperplasia cause compensatory hyperplasia of the parathyroid glandules? And, granted that changes may have occurred in the glandules*

[3] Contribution à l'étude de la Tètanié postopératoire. Extrait des Comptes Rendus du 25° Congrès de l'association Francaise de Chir., 1912.

[4] Quotation from Askanzy: "*Hypophyse.* Les cellules chromophiles ou éosinophiles sont très abondamment développées, d'une richesse même extraordinaire. Par contre il n'y a pas d'augmentation de substance colloide dans les amas cellulaires de l'hypophyse, comme cela se voit dans les hypophyses chez les myxoedémateux. C'est seulement près de la partie nerveuse d'ailleurs intacte, dans la zone intermédiare soit médullaire, que l'on constate quelques follicules à substance colloide conformément à l'aspect ordinaire."

[5] Quotation from MacCallum: "The hypophysis shows rather distinct alterations. The pars nervosa is practically surrounded in the section by the pars intermedia which is perhaps slightly thickened and contains one or two alveoli full of colloid. The pars anterior is in part very deeply stained with eosin, but one portion, and that the major part, is sharply marked off from this eosin-stained tissue by its lilac color. It contains only a few of the bright staining cells, but for the most part is made up of swollen, faintly granular, pale stained cells. These resemble very closely the section obtained by Dr. Homans after injecting pilocarpin. The cleft in the glandular part of the hypophysis is here seen to open into the subarachnoid space." Halsted, J. Exp. Med., 1912, xv, 209.

after thyroid lobectomy, should these consist in the formation of a colloid equivalent to the colloid of the thyroid alveolus if the thyroid-colloid disappears in cases of definite privation and if the accumulation of colloid seems to signify a state of normal or hypo- rather than of hyperactivity?

Furthermore, if hypertrophy of the parathyroids really occurs after thyroidectomy, might it not be due to the unintentional destruction of some of the parathyroids, or even to infection of the wound? I have never observed hypertrophy of a transplanted parathyroid gland. The tendency of these grafts, in my experience, is always to atrophy.

An enormous amount of experimentation must be done before these questions, which are in no sense remote, can be answered. There are hundreds of eager workers in this fascinating field at present who may add immensely to the confusion, before, from the chaos, order eventually can emerge and the simple laws be established of which perhaps we are not even beginning to dream.

Hypertrophy of the thymus gland has frequently been observed in Graves' disease, and from our observations during the past 10 or 11 years of a considerable number of such cases in which the greater part of both thyroid lobes has been removed, we think there is reason to believe that the thymus atrophies in consequence of the operation upon the thyroid. The lymphocytosis gradually disappears, and in none of the earlier cases which have presented themselves this past year for examination has the thymus been skiagraphically visible. It would seem, therefore, that the thymus may be activated by the thyroid.[6]

[6] Support to this view is given by the results of the experiments of A. L. Tatum reported since the reading of this paper (*vid.* J. Exp. Med., June 1, 1913). Tatum finds that in rabbits the thymus atrophies after excision of the thyroid gland.

THE PRELIMINARY LIGATION OF THE THYROID ARTERIES AND OF THE INFERIOR IN PREFERENCE TO THE SUPERIOR ARTERY[1]

It happens that in no instance have we found that the preliminary ligation of two, three or even of the four arteries sufficed to cure the patient seriously ill with Graves' disease, although we have observed that considerable improvement, for a short time at least, may follow the ligation of even a single artery. Ligation in our clinic has been practised only in the most serious cases and always with a view to improving the patient's condition to such an extent that lobectomy might safely be performed and to testing her resistance to operation, hence I have endeavored to reduce the preliminary procedure to the simplest possible terms, ligating each artery through a space just large enough to admit of exposure of the vessel—a space too small, as a rule, to admit more than one finger. For the past two years or more I have tied the inferior in preference to the superior arteries and for the following reasons:

1. The cosmetic effect is better. The incisions for ligation of the superior vessels have to be made at a higher level than the Kocher collar-incision, which is invariably employed for the lobectomy, and there results, in consequence, a welt-like band of skin between the two horizontal cuts which is a pronounced disfigurement.

In tying the inferior vessels the incisions correspond, as I have said, precisely to the line of the lobectomy wound of the skin; and in the making of the latter the fine scars of the former are excised.

2. The wounds made for ligation of the inferior arteries are partly outside of the field of the lobectomy operations, whereas, when the superior arteries have been ligated, a considerable part of the operation for removal of a lobe is through freshly healed, matted tissues whose resistance to infection is lowered. Although suppuration is not very likely to take place even when two or three operations are performed at short intervals through the same tissues, the reaction is greater and breaking down of the wound quite possible.

3. As the inferior thyroid artery is usually larger than the superior, the effect of the ligation may be greater.

[1] Presented before the American Surgical Association, Washington, D. C., May 7, 1913.

Tr. Am. Surg. Ass., Phila., 1913, xxxi, 312-318. (Reprinted.)
Also: Ann Surg., Phila., 1913, lviii, 178-182. Part ii.

4. The superior artery, or arteries, are regularly tied in the course of lobectomy; hence when both inferior arteries have been tied and a double lobectomy is performed all four of the thyroid arteries will have been occluded. On the other hand, if the superior arteries had been ligated at the preliminary operation, the portions of both lobes remaining after a double lobectomy would receive a fuller blood supply.

5. The location of the inferior artery is less variable than that of the superior vessel, which is subject to great changes because of the inconstant position of the superior pole.

The ligation of all the structures of both superior poles through an incision which stretches across the neck—a procedure which has considerable vogue—does not seem quite rational to me for the reason that the results would not be likely to be adequately proportionate to the magnitude of the operation. The ligation of all four of the arteries through small incisions such as I have described, would hardly be more formidable than the operation just referred to and the benefits would, I believe, be greater.

The danger of tetany from the occlusion of the four arteries is probably not so great as I formerly supposed, provided that the ligations are done neatly and at safe distance from the parathyroid glandules. Ligation of the four arteries in close proximity to the parathyroids and through large incisions might result quite differently. In three instances in which I have ligated the four arteries in two or more acts and subsequently removed the greater part of both lobes in the manner about to be described, transient symptoms of tetany manifested themselves.

The inferior thyroid artery is ligated as follows: A transverse cut, from 4 to 4.5 cm. in length, is made over the tendon of the omohyoid muscle precisely in the line of the Kocher-collar incision as contemplated for the subsequent lobectomy. The fibers of the sternomastoid muscle are separated in line of the common carotid artery at the level of the omohyoid tendon. The thyroid lobe is exposed behind the posterior fibres of the sternothyroid muscle and drawn inward by a retractor designed for this purpose. The common carotid is retracted outward by a similar though somewhat shorter instrument and the layers of fascia covering the inferior thyroid artery are divided at the level of the omohyoid tendon. The dissection is then carried out solely with the two long, delicate, blunt dissectors, for the artery is sometimes at a great depth (greatest when the Graves' disease has been engrafted on a colloid goitre), and the space is only large enough, as a rule, to admit one finger between the deeply concave retractors. A special aneurism needle is used for carrying the fine silk ligatures around the artery. The wound is, of course, not drained. The operation, if performed precisely in this manner, is not difficult. Only once have we failed to find the artery in its usual situation; this was about five years ago.

THE EXCISION OF BOTH LOBES OF THE THYROID GLAND FOR THE CURE OF GRAVES' DISEASE[1]

The author has reported the results of his study of 39 cases of Graves' disease in which for the cure of the hyperthyroidism it had been necessary to excise, at two or more operations, the greater portion of both lobes of the thyroid gland. Several of these patients, operated upon as long ago as 1902 and 1903, are still under observation and in quite perfect health.

In all of these cases the second lobe was removed because excision of the first had been followed by insufficient improvement. In several instances in which the ligation of three arteries plus the excision of one lobe had been attended with almost negative results, relief from all symptoms followed immediately upon the removal of the remaining lobe; hence the advisability, repeatedly emphasized by him in his publications, of operating upon the first lobe in such manner that the second may be excised without danger of tetany. A small slice of each thyroid lobe is left in order to protect the circulation of the parathyroid glandules. The operation is performed in an absolutely bloodless manner, all of the blood vessels supplying the lobe being clamped (but not ligated until after the lobe has been cut away) at a safe distance from the parathyroids.

No muscles are divided in the course of the operation except a few of the fibres (usually the posterior fibres) of the sternothyroid. Haemostasis is attended to with scrupulous care and the wounds are closed without drainage. There has been no death in this group from operation, although, in general, it includes the most serious cases, so serious that, in the majority of them, preliminary ligation of one or more arteries was done. In one case the four arteries were tied, at as many operations, before the lobectomy was hazarded.

Kocher having emphasized the importance of lymphocytosis in hyperthyroidism, a differential leukocyte count has been made. Almost invariably the proportion of lymphocytes was increased, once being as high as 65 per cent. But in one case, the most serious of all, the total percentage of lymphocytes was only nine. It has particularly interested the writer to observe that there has been a gradual reduction, after operation, of the lymphocytosis in these cases.

[1] Presented before the American Surgical Association, Washington, D. C., May 7, 1913.

Tr. Am. Surg. Ass., Phila., 1913, xxxi, 319-321. (Reprinted.)

Also: Ann. Surg., Phila., 1913, lviii, 178-182. Part i.

The rôle of the thymus in Graves' disease is probably of great importance. With the advances in skiagraphy it has become possible to detect enlargement of the thymus too slight to be determined by percussion. It seems probable that in a large percentage (75 per cent or more) of the pronounced cases the thymus is enlarged.

The hyperplastic thymus may be in great measure responsible for the disproportionate number of the mononuclear leukocytes. In one of the cases, a boy, aged 16 years, with only mild hyperthyroidism, the lymphocyte percentage was 56, and there was enlargement of the thymus so great that the author could easily remove a part of it from the ordinary collar incision of Kocher.

In none of the cured cases which returned for observation during the past winter was evidence of persistence of the thymus found skiagraphically, and in none of these was the percentage of lymphocytes above 33.

The tendency, after removal of one lobe, is towards lessening the hyperplasia in the other. This tendency is probably greatest in the cases which improve most. In these, unfortunately, we have no opportunity to see the other lobe, for there is no indication to excise it.

When the second lobe is removed it is always because patients are not sufficiently benefited by the removal of the first lobe.

In some the second operation is done promptly (two to four weeks after the first) and in these the interval is so short and the improvement from the first operation so slight that great change in the histological picture is not to be expected.

And when the interval has been long the second operation may have been delayed by the patient until she is in worse condition than originally, and the hyperplasia has become correspondingly advanced.

Sometimes the second lobe has been removed several years after the first and when the patient was still vastly better than before the first lobectomy. In these patients the improvement in the histological picture may be considerable.

THE SIGNIFICANCE OF THE THYMUS GLAND IN GRAVES' DISEASE[1]

It was perhaps in 1849 that the first experimental proof was brought of the action which a ductless gland might exercise upon the organism. Berthold, professor in Göttingen, transplanted the testicles of young cocks and noted that the birds so treated developed the masculine voice, sexual desire, comb and love of combat. He thus in considerable measure anticipated Brown Sequard, to whom the doctrine of internal secretions is generally accredited and who 20 years after Berthold, committed himself to the view that a gland, whether possessed of ducts or not, elaborated substances which were essential to the growth and maintenance of the body and for the preservation of health. It was a memorable meeting of the Société de Biologie of Paris at which, two decades after his first pronouncement, this supergifted man related in support of his views the results of experiments made upon himself. He testified, as you recall, that following the injection of testicular juice he observed an astonishing revivification of his physical and mental powers.

One of the least understood and most complicated of the various distinct but intimately associated mechanisms at work in sustaining the orderly activity of the animal body is what has been termed the chemical correlation. Each organ, each tissue and each cell of the organism may exert a chemical influence upon some other far removed tissue of the body and thus aid in bringing about the adaptations and readjustments essential for the integrity and life of the whole.

The acid chyme passing into the duodenum stimulates the epithelial cells of the mucosa to the production of a substance which by way of the blood stream calls forth responses in pancreas, intestines and liver, exciting the secretion of pancreatic and intestinal juices and of bile. Bayliss and Starling proposed the name Hormones (ὁρμάω, to awaken, stir up) for such physiological products as serve to arouse the various organs to activity.

[1] The Harvey Lecture. Delivered before the New York Academy of Medicine, New York, March 14, 1914. Also presented before the American Surgical Association, New York, April 9-11, 1914.

Harvey Lect., 1913-1914, Phila. and Lond., 1914, ix, 224-255.

Also: Johns Hopkins Hosp. Bull., Balt., 1914, xxv, 223-234. (Reprinted.)

Also: Tr. Am. Surg. Ass., Phila., 1914, xxxii, 287-321.

Also: (Abstr.) N. York M. J., 1914, xcix, 638-640.

The structures which produce Hormones are commonly called endocrine (κρινεῖν, to separate) organs or glands of internal secretion.

Meltzer believes that, strictly speaking, such products of the chemical action of organs as must be regarded as terminal resultants of the decomposition processes, as the waste or by-products of metamorphosis, products which enter the circulation merely for the purpose of prompt elimination, should be differentiated from those substances which, formed in specific manner in individual or special organs, are taken up by the circulation and carried to distant parts, there to fulfill particular functions. Only these latter substances should, in the opinion of Meltzer, Gley and others properly be designated as Hormones, and Gley has proposed the appellation Parhormone for the decomposition products which invariably result from cellular activity and which as irritants might exercise a deleterious influence did not the fluids and tissues of the body form definite protective reactions.

Hormones can in two ways exercise their functions either by direct action upon the tissues or by means of the nervous system. In addition to these relatively direct methods of manifesting their action upon the terminal apparatus it is quite certain that the secretion of a given gland may act indirectly or through the agency of other hormonopoetic organs. For example, the influence of the thyroid by way of the thymus upon the activities of the stomach. To what extent the visceral nervous system plays a part and what may be the sequence of events in the course of the complicated interaction of the endocrine glands may in a measure be determined by experimental studies in metabolism. Thus it has been ascertained that in animals the glycosuria which develops on administration of adrenalin vanishes after excision of the thyroids. If these animals are now fed with thyroid extract the glycosuria reappears. On the other hand, in the pancreatectomized animals excision of the thyroid does not cause the glycosuria to disappear.

Studies in metabolism have taught us that the thyroid and pancreas on the one hand and the pancreas and chromofine system on the other reciprocally inhibit. Between the thyroid and chromofine system, however, there exists a reciprocal potentiation. Hence when hyperthyroidism gives rise to glycosuria it may conceivably do so by inhibiting the pancreas. In a still more roundabout way the thymus via thyroid, via pancreas might possibly bring about glycosuria unless, perhaps, the influence of the thymus upon the adrenals were protective.

"Modern pharmacology regards as antagonists the sympathetic and autonomic [2] nervous system. As the sympathetic system possesses in adrenalin

[2] This word is used in the restricted sense, and not as intended by Langley who proposed the term *autonomic* for the entire sympathetic system.

a specific pharmacological stimulant so analogously the autonomic system has in pilocarpin and muscarin its specific irritants. One can by the administration of thyroid extract produce symptoms in animals and man which strikingly resemble the stimulating effects of pilocarpin or muscarin (sweating, diarrhoea, disturbances in respiration, lymphocytosis, eosinophilia, etc.).

"The standpoint has accordingly been taken that in the thyroid there is a constituent which produces an effect similar to that of the poisons of the pilocarpin group. In favor of this view speaks, especially, the well-known antagonism between thyroid extracts and atropin, which is an antidote for pilocarpin and muscarin. It has now been attempted on the basis of these physiological facts, which indicate that from the thyroid gland impulses may be sent out along the tracts of the sympathetic as well as the autonomic system, to distinguish the symptoms of Graves' disease which might be due to irritation of the sympathetic from those which might be attributed to autonomic stimulation." (Eppinger.)

Sympathicotonic Basedow Symptoms

1. Pronounced protrusio bulbi.
2. Von Graefe, absent.
3. Löwi's phenomenon, positive.
4. Möbius, positive.
5. Dry bulbs.
6. Greatly increased activity of the heart with less pronounced subjective disturbances.
7. Sweating and diarrhoea, absent.
8. Falling out of hair.
9. Eosinophilia, absent.
10. Inclination to fever.
11. Alimentary glycosuria.
12. Refractory behavior to pilocarpin.

Vagotonic Symptoms

1. Relatively moderate degree of tachycardia.
2. Pronounced subjective heart symptoms.
3. Von Graefe, definite.
4. Wide lid-clefts.
5. Möbius, absent.
6. Slight protrusio bulbi.
7. Increased lachrymation.
8. Profuse sweating.
9. Diarrhoea.

10. Disturbances of digestion.
11. Eosinophilia, likely.
12. Alimentary glycosuria, absent.
13. No adrenalin-glycosuria.
14. Pigmentation.

There are certain exceptional, more or less sharply differentiated cases of Graves' disease which every physician and surgeon who has actively interested himself in the subject must vividly recall. During the past 23 years in a series of about 500 I have seen perhaps 20 which were especially typical of their kind. The characteristic features which most of them presented were great emaciation, dilatation of the heart, sweating, diarrhoea, relatively slight exophthalmus, not excessive tachycardia, small goitre, and frequently a peculiar greyish bronze-hued skin.

Confronted with a case of this kind, I have repeatedly said to my assistants:

"Here is another of these puzzling, dreadful cases. The patient is not highly thyrotoxic; the thyroid is hard, not large, nor pronouncedly vascular; if a lobectomy is performed she may die, but probably not with the stormy symptoms which suggest extreme thyroid intoxication. If death occurs it may be sudden, possibly not until several days after the operation, and perhaps when the patient seems to be convalescing."

In one of these cases death occurred four days after the ligation of a single artery under local anaesthesia. The operation, including the injection of the local anaesthetic and the sewing up of the tiny wound, required exactly ten minutes. One night, as I have said, four days after the operation, and a few minutes after the nurse had charted the pulse as 90, the patient awoke with a start, sat upright in bed, gasped for breath and died. The following case died suddenly about 30 hours after a thyroid lobectomy when we had ceased to be apprehensive about her:

Case 1.—A. V. C. (No. 33010). Aet. 47. Admitted October 8, 1913. Except for whooping cough at the age of 15, mumps at 19 and measles at 21, patient states that she has enjoyed good health until about four years ago.

In January, 1909, patient experienced on swallowing the sensation of a "lump in her throat." At about the same time she was seized with a severe headache, became very nervous, suffered from palpitation and vomited several times. Thinks she had fever in this attack. Almost immediately the thyroid gland "began to swell." She was quite ill for three or four months but in May of the same year felt as well as ever. Her recovery was so complete that she considered herself in normal health until January, 1913, when she was taken ill again quite suddenly with precisely the same symptoms as in the previous attack. Palpitation and shortness of breath were more pronounced than at first; diarrhoea, vomiting and difficulty in swallowing also

became troublesome symptoms. Cessation of the menses occurred about that time. Since July 1, 1913, she has been confined to bed.

Examination.—Patient is greatly emaciated (weight 67 pounds); is very nervous, constantly jerking about and tossing her head; there is fine tremor of the fingers and tongue. She has decided mental aberration, ideas of persecution and grandeur; has bad dreams; talks to angels; is confident that her mind is affected, etc. Has staring expression; is very nervous; the whole body seems to be shaken by the heart-beat. The skin is ashy-bronze in hue. There is slight exophthalmus; definite von Graefe; convergence fair; rather wide palpebral clefts, but sclera covered. Joffroy sign absent; pupils react to light and accommodation. The hair is dry, grey, thin and falling out. Thyroid uniformly and moderately enlarged and very firm. Faint bruit but no thrill over thyroid arteries. No palpable enlargement of any lymphatic glands. The carotids throb forcibly. Veins of neck pulsate. There is great emaciation; deep supra- and subclavicular fossae. Movements of respiration symmetrical. Lungs clear. Respiration 28. Thymus: there is no definite retromanubrial dullness; X-ray negative. The heart is greatly dilated. There is a soft blowing systolic murmur over the whole cardiac area; it is heard best at apex. Pulse 140 to 155 and over per minute, and irregular. Arteries not hardened, blood pressure 115 to 125. Abdomen scaphoid. Marked aortic pulsation. Edge of liver not palpable.

Blood.—White corpuscles, 13,360; red, 4,404,000; haemoglobin 61 per cent.

October 13, 1913.—Differential Blood Count: Two hundred and fifty cells counted.

	Cells	Percentage	Actual number of each in c.mm
Polymorphonuclear neutrophiles	128	51.2	6840
Small mononuclears	86	34.4	4595
Large mononuclears	21	8.4	1222
Transitionals	5	2.0	267
Eosinophiles	3	1.2	160
Basophiles	1	.4	64
Unclassified	7	2.8	374
Myelocytes	2	.8	106

October 20, 1913.—Patient vomited frequently until five days ago. Has two to three or more watery stools a day. Has persistent cough.

October 21, 1913.—Operation I: Ligation of Left Inferior Thyroid Artery. The artery was easily found and tied. It was as large as a vertebral artery. Patient's pulse rose to 200 and over during the operation under novocain, nitrous oxide gas, and a few drops of ether.

October 24, 1913.—Patient remarkably improved since the operation. Restlessness greatly relieved. Vomiting has ceased. Pulse now averages only 100.

October 25, 1913.—Operation II: Gas. Ligation of Right Inferior Thyroid Artery. Artery very large, very thin-walled and blue like a vein. Operation required only a few minutes.

October 30, 1913.—Patient has improved rapidly since second operation. Is quite cheerful. Hair regaining lustre.

October 30, 1913.—Differential Blood Count: Two hundred and fifty cells counted. White blood cells 8300.

	Cells	Percentage	Actual number of each in c.mm.
Polymorphonuclear neutrophiles	122	48.8	3984
Large mononuclears	37	14.8	121
Small mononuclears	69	27.6	2201
Transitionals	21	8.4	704
Eosinophiles	1	.4	41

November 4, 1913.—Marked improvement in patient's general condition. Pulse 88. Patient eats heartily; neither vomiting nor nausea.

November 11, 1913.—No pronounced change in patient's condition during the past week. Appetite large but there has been no gain in weight (60 pounds).

November 16, 1913.—Patient has gained 4¾ pounds in past five days.

November 24, 1913.—No definite improvement during past week.

November 25, 1913.—Operation III: Right Lobectomy. Gas and a few drops of ether. Operation simple and rapid. Patient's pulse rose only occasionally to 180, but was usually about 160 during the operation. At the first operation it rose to 200 and over. At the end of the operation the patient's condition was excellent.

November 26, 1913.—Differential Blood Count: Two hundred and fifty cells counted. White blood cells 18,400.

	Cells	Percentage	Actual number of each in c.mm.
Polymorphonuclears	155	62.0	11,408.0
Small mononuclears	51	20.4	3,753.6
Large mononuclears	22	8.8	1,619.2
Transitionals	8	3.2	588.8
Eosinophiles	5	2.0	368.0
Basophiles	5	2.0	368.0
Unidentified	4	1.6	294.4

November 26, 1913.—Patient had a fairly comfortable night and seemed to be convalescing satisfactorily until 1.20 p. m. today when she was found sitting up cyanotic and gasping for breath, coughing, trying to clear her throat, excited and apprehensive. Pulse very irregular. Respirations 40 to 50. Area of precordial dullness markedly increased, extending 4 cm. to the right and 10 cm. to the left of the median line. At 1.50 p. m. she became quiet, seemed fairly comfortable and dozed. Pulse 140 to 180 and irregular in force and rhythm. Cyanosis less.

3.40 p. m. Suddenly seized with another dyspnoeic attack. Respirations became more labored and at 4.05 p. m. ceased. The heart apparently stopped beating about one minute before the cessation of respiration. The temperature rose to 101.5° F.

Autopsy (Dr. Reid).—Subject strikingly emaciated. Left lobe of thyroid slightly enlarged; small slice of right lobe in region of the parathyroids. Cardiac dilatation. Emphysema of both lungs; bronchopneumonia. Large

thymus extending down to the auricles. Fatty degeneration and atrophy of liver; small adenoma of liver. Mesenteric glands rather larger than normal; otherwise no enlargement elsewhere of the lymphatic glands. Dilated, atrophic stomach. The thymus gland was thick but not broad enough to cast an X-ray shadow beyond the manubrium. It was triangular in shape, the finely tapered apex reaching to the top of the manubrium, the broad base extending to and partly covering the auricles of the heart.

The endocrine glands have been carefully studied microscopically and will probably be reported upon at other times by the various men to whom these organs were specially entrusted. I was particularly interested to find that in the thyroid glands the follicles instead of showing the usual picture found in exophthalmic goitre were for the most part circular and distended with densely staining colloid without vacuolation. The epithelial cells were low-cuboidal or flat. In places, however, throughout the gland the colloid was rarefied and the cells high.

In this patient the vagotonic symptoms predominated (diarrhoea, vomiting, small goitre, slight exophthalmus, definite von Graefe, Möbius not pronounced, intense subjective symptoms, pigmentation).

Was this a case of thymus death?

Physiologists, pharmacologists, pathologists and clinicians are rapidly reflecting, consciously and unconsciously, helpful light for the interpretation of the clinical phenomena and dire results in cases belonging more or less definitely to this category.

In 1910 Meltzer[8] made the following cautious statement concerning the thymus gland:

"With our present knowledge of the importance of the other ductless glands we are hardly justified in assuming that the thymus is a worthless fetal remnant. But we have to acknowledge that as yet there are no reliable observations or experiments which indicate clearly that the thymus has a function in postuterine life."

Von Mikulicz (1895) called attention to the occurrence of enlarged thymus in severe cases of exophthalmic goitre, and Rehn (1899) suggested that it might be well to attack the thymus gland surgically in this disease. In 1908 Hart expressed the opinion that abnormal activity of the thymus gland might produce the clinical picture of Graves' disease.

It was my good fortune to be present when Garrè, at the 40th Congress of the Deutsche Gesellschaft für Chirurgie (1911) took part in the discussion of Kocher's paper on exophthalmic goitre in order to report the first instance in which the thymus had been primarily removed for the cure of this disease. Although well aware of the fact that a "persistent" or revivi-

[8] Meltzer: Animal Experimentation in Relation to Our Knowledge of Secretions, Especially Internal Secretions. Proc. of the Path. Soc. of Phila., Sept., 1910.

fied thymus had repeatedly been observed in " Basedow " he was astonished to learn from the statistics obtained by his assistant, Dr. Capelle, that a thymus persistens hyperplastica had been found in 95 per cent of the fatal cases, whether death was due simply to the severity of the disease, or occurred during the operation, or within 24 hours after the strumectomy.

So impressed was Garrè with these findings that he finally determined to test the effect of thymectomy in cases in which there was good reason to believe that the thymus was enlarged. It seemed to him that a severe and florid example of Basedow should be selected for the experiment and that the thyroid gland should be unmolested in the operation, the purpose of which was to determine the effect of a thymectomy upon the symptoms of the disease.

The result in his first case was as follows:

" Clinically no definite influence on the struma, the exophthalmus or the eye symptoms, but an unequivocal improvement in the general condition as expressed by the " éclatant " quieting of the heart's action, rapid increase in weight, and a complete regression of the Kocher blood-picture, the lymphocytes falling from 40 to 25 and then to 10 per cent."

In his second case Garrè performed simultaneously a hemistrumectomy and thymectomy.

The striking results which followed the first of these operations forced upon him the thought that the hyperplastic thymus in exophthalmic goitre displays an action essentially similar to that of the thyroid and that the thymus persistens aggravates the symptoms of the disease.

Professor Garrè gave to his assistant, Dr. Capelle, credit for the work and the thought which led them both to these conditions, which he said finds essential support in the proof by Klose that in the thymus-substance there is a heart-poison. Aside from the special action of the thymus, there exist certainly, said Garrè, important reciprocal relations between these two glands, and for the following reasons:

1. After thymus extirpation, the blood-picture, which, by Kocher, is considered characteristic of Graves' disease, returned to normal precisely as after a successful strumectomy.

2. His assistant, Dr. Bayer, had recently demonstrated that intraperitonaeal injections of the expressed juices of the thyroid as well as of the thymus produce the Kocher blood-picture, whereas the juices of colloid struma and of normal thymus influence the blood-picture to a much less extent.

3. They found in a thyroid gland which had been removed six months after a thymectomy microscopical evidence of regressive changes.

4. Gebele had announced at the previous Congress that the prompt implantation of normal thymus in thyroidectomized dogs prevented the appearance of cachexia strumipriva.

5. He was able to state, thanks to the permission of Dr. Bircher, that the latter had twice produced the typical Basedow picture by the intraperitonaeal implantation of the fresh, pathologically hyperplastic thymus. These and other facts made him unable to subscribe to the generally accepted view of Möbius that the thyroid is alone responsible for the disease. On the other hand he was not prepared to take the extreme view of Hart that there was a purely thymogenic form of Basedow.

I have presented in such detail the views so briefly and cautiously expressed in 1911 by the highly gifted director of the surgical clinic in Bonn because this contribution of Garrè and Capelle marks an epoch in the developing story of Graves' disease and its treatment, the importance of which is as yet not realized.

During the past three years the research work on the thymus, which already had been considerable, has assumed great proportions, and for surgeons interested in Graves' disease this gland has become a theme on which their attention may well be focused.

And now, just a few weeks ago, appears a most convincing paper by von Haberer, the youngest of Billroth's assistants, and, until his promotion to the directorship of the Innsbruck surgical clinic, first assistant to von Eiselsberg in Vienna, who is also a distinguished product of the school of Billroth. The results of thymectomy in von Haberer's case (No. 3), are so remarkable as to be almost unbelievable were they recounted by an authority less eminent and trustworthy.

Case 3.—Von Haberer.[4] Merchant, aet. 30; in his earlier years athletic; of late overworked in his business, but well until the autumn of 1909, when after an attack of fever, he noticed a marked increase in the frequency of his pulse, loss of zeal for work and a feeling of general bodily discomfort. About six months later he observed that his eyes were abnormally prominent, that he was becoming nervous and tremulous and subject to attacks of profuse sweating, and that he experienced feelings of cold in the legs. The greatly increased and irregular action of his heart caused him especial uneasiness. In the spring of 1911 a part of the thyroid gland was removed, and thereafter, for a time, his symptoms, the tachycardia excepted, were somewhat relieved. In the winter of 1911, after unusual business stress, the heart symptoms became greatly intensified and haemoptysis and dyspnoea supervened. The dyspnoea became so great that the patient was apprehensive at times lest he choke to death. He sought relief at the hands of Professor Kocher in Berne, who ligated the thyroid arteries of the unremoved lobe. No relief was obtained from the arterial ligation, on the con-

[4] Mitteilungen aus den Grenzgebieten der Med. u. Chir., Bd. xxvii, Heft 2, p. 210.

trary the patient's condition became alarmingly worse. He frequently had attacks in which a bloody froth was expectorated and consciousness lost. He finally could not walk without provoking these attacks.

On the seventh of December, 1912, the patient presented himself at the clinic in Innsbruck of von Haberer. He was cyanotic, gasping for breath and covered with cold sweat; the pulse could not be felt in the peripheral arteries. Fearing that the man might die in his office, Professor von Haberer had him hastily despatched to a sanatorium. After a short rest in bed in a half sitting posture (the only one endurable for the patient) the pulse returned at the wrist. It was 160, very irregular and unequal. Exophthalmus was particularly pronounced on the right side; skin and mucous membranes cyanosed; slight von Graefe and Möbius signs on both sides; tremor and great dyspnoea; right lobe of thyroid very slightly enlarged; left lobe not palpable. Over both lungs signs of oedema and congestion-bronchitis; heart much enlarged, extending on the left side, four finger-breadths outside of the mammary line. Liver greatly increased in size, its lower thick border extending as low as the navel. Slight but definite icterus. Compression of the trachea by the thymus was excluded both by percussion and the Roentgen ray. There was, however, behind the manubrium a triangular shadow which, without demarcation, blended with the shadow of the heart. Percussion revealed no unusual dullness.

The patient begged piteously for operation, indifferent to its dangers; desirous only to be relieved of his great distress. Professor von Haberer refused to interfere surgically, being convinced that if an operation were undertaken at that time it would result fatally. The physician called in consultation agreed that the patient's condition was hopeless, the heart being exhausted. The thyroid symptoms he regarded as a complication of relatively minor importance and believed that medication would accomplish nothing for the heart. The patient was kept in bed and treated with diuretin and digotoxin. In the course of 10 days the condition of the lungs was somewhat improved, but the pulse, never dropping below 140, remained irregular with frequent periods of galloping rhythm. The differential blood count gave polynuclears 57 per cent; small lymphocytes 27.6 per cent; large lymphocytes, mononuclears and transitionals 12.3 per cent; eosinophiles 2.9 per cent; mast cells 0.2 per cent; coagulation was slightly delayed.

December 19, 1912.—All were still agreed, and the patient assured, that he could not survive an operation of any sort. Nevertheless, von Haberer, having in mind the somewhat analogous case of Garrè's, finally decided to yield to the patient's entreaties, and on December 19th, under local anaesthesia, succeeded after prolonged search in extracting from behind the manubrium a piece of tissue 3 cm. long and ½ cm. thick, which resembled fat and macroscopically seemed to contain no thymus gland. Greatly disappointed at the result of the operation and believing that the last hope for the patient had vanished, von Haberer closed the wound. Towards evening of the same day the patient announced that he felt much better and that his dyspnoea had disappeared. On the fourth day after the operation he became much worse; the pulse was feebler and more frequent, the liver increased in size and the icterus deepened. The following morning, however, and each day thereafter improvement was noted, and on the third of Janu-

ary, 1913, two weeks after the operation, the patient was discharged from the hospital. Three months later (April, 1913) he returned for examination. The surgeons and physicians were astonished at the result. The apex beat was in the mammary line, the pulse 84, although still irregular, the cyanosis and icterus had disappeared; the liver was of normal size, and the color of the skin was good and fresh. The subjective condition was as satisfactory as the objective. The patient declared that he felt perfectly well; he could work as tirelessly as ever and could even climb mountains. In September of the same year this patient wrote that he had climbed for sport a mountain over 7500 feet high.

Three primary thymectomies have been reported, all of them from Garrè's clinic. To these may, however, be added Sauerbruch's case in which only the ligation of one superior thyroid artery preceded the operation on the thymus. In all of these cases the effect of the operation upon the general condition of the patient and upon the blood-picture was unequivocally beneficial. Of the combined operation, thyroidectomy plus thymectomy, eight cases have been reported by von Haberer; and Capelle and Bayer state that several times in the clinic of Garrè this operation has been performed.

Klose states in his recent book on the thymus gland that he has in five cases of Basedow's disease resected the thymus. In each instance there was striking improvement in the patient's general condition and return of the blood-picture to the normal. I have excised a small portion of the thymus with one lobe of the thyroid in two cases of which I shall speak later.

It has been our practice of late in the strumectomy operations to investigate the contents of the space between the trachea and the manubrium with the object of determining the possible presence of an enlarged thymus, and in a few instances we have made a fairly thorough search for this gland. Only twice have we found it enlarged; in both instances we should have been disappointed had there been no traces of thymus and our faith in some of the most important strands of the complicated web which the pharmacologists, the physiologists and the clinicians are weaving to represent the interdependent activities of the endocrine glands would have been shaken.

Case 2.—H. P. (Sur. No. 31648). Aet. 13. Admitted to the Hospital March 6, 1913.

Complains of difficulty in breathing, "feeling lazy," and inability to work. During the past four or five years he has had attacks of vertigo, occasionally with loss of consciousness; also attacks of nausea and vomiting preceded usually by headache. Patient might remain in bed for a week after such attacks.

Patient believes that his present illness began two years ago. He noticed first a swelling in the neck which has gradually increased in size; then began to have shortness of breath and the sensation of pressure on the trachea. He could not read aloud for any length of time. He could not run or ascend stairs quickly. During the past five months he has had dyspnoea on lying down and has been unable to sleep on less than three pillows. Ambition for

work and play is lost. He is unable to talk loud and finds it impossible to shout. Has a hoarse cough and desire to clear the throat. For the past four or five months he has experienced some difficulty in the swallowing of solid foods, and at times even of liquids; his bowels are evacuated four or five times a day. He has occasional attacks of vomiting before breakfast. Has become irritable. Has not observed palpitation of the heart. Does not perspire excessively.

Physical Examination.—Boy is well nourished and well developed. The hair is oily; the skin neither abnormally dry nor abnormally moist. There is no exophthalmus; the von Graefe sign is positive at times; the other eye-signs are absent. The thyroid gland is enlarged to perhaps three or four times its normal size. There is definite retromanubrial dullness. The X-ray shows a suggestive shadow. A soft systolic bruit is heard over a very slightly enlarged heart. The pulse is regular, 80 beats per minute. Tremor absent. Cervical, inguinal, submaxillary and axillary glands are palpable.

March 7, 1913.—Differential Blood Count: Three hundred cells counted.

	Cells	Percentage
Polymorphonuclear neutrophiles	160	53.3
Small mononuclears	102	34.0
Large mononuclears	23	7.6
Transitionals	8	2.7
Eosinophiles	3	1.0
Basophiles	2	0.7
Unclassified	2	0.7

March 18, 1913.—Operation: Excision of Right Lobe and Isthmus of Thyroid and a Small Piece of Thymus.

March 26, 1913.—Differential Blood Count:

	Cells	Percentage
Polymorphonuclear neutrophiles	183	61.0
Small mononuclears	86	28.6
Large mononuclears	15	5.0
Transitionals	7	2.33
Eosinophiles	2	.6+
Basophiles	2	.6+
Unclassified	5	1.6

December 11, 1913 (nine months after operation).—*Differential Blood Count:*

	Per cent
Polymorphonuclears	68.0
Small mononuclears	23.0
Large mononuclears	5.0
Transitionals	3.0
Eosinophiles	1.0

February, 1914.—Examination: The boy's health is almost restored. He is able to do a full day's work, but is rather more fatigued by it than are other boys of the same age. He can sleep on one pillow and has had no attacks of vertigo, nausea or vomiting since the operation. The cough and difficulty in swallowing have disappeared. The diarrhoea has ceased.

As the operation in this case was a combined one, the great improvement which followed it cannot definitely be attributed to resection of the gland alone. The portion of thymus resected was, however, so small that I am inclined to believe that the strumectomy rather than the thymectomy was chiefly responsible for the good result.

Case 3.—G. B. (No. 94086). Aet. 12 years. Admitted to the hospital February 12, 1914.

Has had most of the infectious diseases of childhood (whooping cough, measles, scarlet fever, chickenpox, mumps), all before she was seven years old. Occasionally has sore throat but has never had a definite attack of tonsillitis. Function of eyes and ears normal. Has always been a nervous child with poor appetite. Digestion apparently good, although she has each year two or three "bilious attacks" with nausea and vomiting. For the past five years the mother has had difficulty in fitting the collars of her child's dresses, but not until a few months ago did she notice that the neck was enlarged. The eyes have always been prominent, protruding at times more than at others. For the past three or four years the child has complained of a feeling of fullness in the neck, especially when tired and nervous.

Examination.—A rather pale, sallow-looking, frail girl. Expression alert and intelligent. She is unusually clever in conversation. Not obviously nervous at present. Hair normally lustrous. Hands and feet warm and rather moist. No pigmentation of skin. Dermatographia. No dilatation of superficial vessels of forehead or temples. Possibly slight fullness of veins of upper eyelids. Eyes decidedly prominent. Sclera well covered by lids. Palpebral clefts 1 cm. A suggestive stare. Von Graefe doubtful. No other eye-signs. Pupils react to light and accommodation. Slight tremor of tongue, none of fingers. Pulse regular; 100 beats per minute. Accentuated throbbing of the carotids, particularly of the right carotid. Dilatation of superficial veins of neck on both sides. Neck enlarged; rather more so on the right than on the left side. Both lobes of thyroid palpable, the right more definitely than the left. The isthmus is prominent and measures 2.5 cm. vertically. There is neither bruit nor thrill in the gland. Circumference of neck over the isthmus is 28 cm. The entire gland seems of normal or rather soft consistence. There is a suspicion of retromanubrial dullness. The X-ray reveals, however, no shadow suggestive of the thymus gland.

Tonsils markedly enlarged; crypts visible. Posterior cervical and axillary glands are palpable. Finger tips are slightly clubbed. Child complains of palpitation of the heart and shortness of breath on exertion. States that on two or three occasions she has been obliged at night to sit upright in bed to relieve a feeling of slight suffocation. Has usually two and sometimes three stools a day. Has never been constipated.

February 12, 1914.—Differential Blood Count: White blood cells 7000. Haemoglobin 92 per cent.

	Cells	Percentage
Polymorphonuclear neutrophiles	120	60.0
Small mononuclears	71	35.5
Large mononuclears	5	2.5
Transitionals	3	1.5
Eosinophiles	1	.5

February 19, 1914.—Operation: Resected Right Lobe of Thyroid and a Small Piece of Thymus Gland. The right lobe of the thyroid, about 2½ times the normal size, was resected according to our regular method, a portion of the posterior part being left to protect the parathyroids and the recurrent laryngeal nerve.

The thymus gland was found to extend upwards almost to the inferior pole of the right lobe of the thyroid. The piece of the thymus resected was hardly larger than the child's little finger.

February 21, 1914 (two days after operation).—Differential Blood Count:

	Cells	Percentage
Polymorphonuclear neutrophiles	154	77.0
Small mononuclears	25	12.5
Large mononuclears	11	5.5
Transitionals	10	5.0

It is interesting to note the fall in mononucleosis. Nine days before the operation the percentage of mononuclears was 38; two days after the operation it had fallen to 18. The child and mother are greatly pleased with the general improvement which they think has taken place since the operation. It is too soon for us to judge of this.

It is the belief of the few who have expressed an opinion on the subject that the overactivity of the thymus manifests itself chiefly or only after the hyperthyroidism has existed for some time—that it is not observed in the early stage of the disease.

In my patients two and three the thymus symptoms predominated (attacks of dyspnoea, diarrhoea, no tachycardia, not much enlargement of the thyroid and not very definite eye symptoms).

So one cannot but feel that the hyperthymusism may have been primary in these cases and that later on the thyroid symptoms might have predominated. We shall try to follow carefully the subsequent history of these children; and as only a part of one lobe of the thyroid and a very small portion of the thymus of each child was removed we may not have influenced profoundly the natural development of the disease.

A case upon which a double thyroid lobectomy was done two years ago returned recently for examination. The thymus being still enlarged it was treated for four hours by the emanations of 1300 milligrams of radium applied over 16 squares. Although there has been after 10 days no reduction in the size or density of the X-ray shadow, two thyroid nodules, as large as filberts, hypertrophied remnants of isthmus, entirely disappeared within 24 hours. Dr. Burnam, who applied the radium at Dr. Kelly's Sanatorium, believes that the thyroid nodules vanished because of the inhibited activity of the thymus. He thinks it is exceedingly unlikely that the emanations could have directly affected the thyroid.

The results of the combined operations have been, without exception, remarkably good; unmistakably better, I should say, than we ordinarily obtain from the operation upon the thyroid gland alone. Particularly striking has been the relative absence of the reaction which is usually observed in the 36 or 48 hours following thyroid lobectomy. The postoperative course in the experience of von Haberer could not be distinguished from that observed after operations for ordinary struma. This seems the more remarkable because in all these cases there was the complication of an enlarged and persistent thymus. The improvement was immediate and so strikingly pronounced that I agree with von Haberer in believing that it must be attributed to something more than mere accident.

That the thymus plays an important part in Graves' disease has, I think, been demonstrated beyond question by the results which have followed thymectomy. That some sort of relation exists between the two organs we have further evidence from the physical examination of the nonfatal cases, from the autopsy table, and from experiments on animals.

Palpation just above the manubrium, particularly pressure downwards towards the mediastinum, and over extension of the head, may be complained of by patients with persistent thymus on account of the shortness of breath occasioned by these manoeuvers. The Roentgen-ray and the percussion-note over the area occupied by the thymus may give useful information; but the absence of both dullness and shadow does not exclude the presence of a persistent gland, nor do we know as yet how small a thymus may be responsible for symptoms.

It has been estimated as a result of nonoperative clinical examination that in about 40 per cent of all cases of exophthalmic goitre the thymus is persistent. The actual percentage it remains possibly for the surgeon to determine by systematic exploration. We have, I think, no absolute evidence that the thymus may be completely wanting in a case of Graves' disease; and since, as I have stated, we do not know how small a fragment of this gland may suffice to play a part in the disease, we are not as yet in a position to assert that exophthalmic goitre may exist entirely uninfluenced by the thymus. Von Haberer, however, reports an outspoken case in which careful operative search failed to reveal its presence.

Enlarged thymus not infrequently accompanies colloid goitre. Attention was called by Astley Cooper and by Virchow to this association. The question naturally suggests itself, has the persistent thymus the same significance in both these forms of goitre, one of which we hold accountable for symptoms of hyperthyroidism, whereas with the other the picture of underactivity of the thyroid is associated? Is it not conceivable that the persistent thymus in colloid goitre may in some cases represent responses from time

to time to periods of perhaps overlooked, hyperfunction of the thyroid, and if so that indeed for the "Kropfherz," a contributing factor may be found in the thymus?

From the postmortem examination of cases of exophthalmic goitre which have died of intercurrent disease it has been ascertained that the thymus gland is persistent in about 82 per cent of them; and in those cases which have died of heart failure after operation enlargement has been found, as already stated, in about 95 per cent. Probably it will be ascertained that the percentage has been underestimated for the reason that enlargement of the thymus may not hitherto have been so completely noted or looked for as it will be in the future. Then, too, we must bear in mind the important lesson taught us from von Haberer's Case No. 3, that the severest thymotoxic symptoms may be caused by fragments of thymus so small as to be unrecognizable as such by the naked eye.

At The Johns Hopkins Hospital there has been only one opportunity to make an autopsy on a case of Graves' disease which died after operation. In this instance, as I have mentioned, a long, thick thymus gland was found tapering out from near the top of the manubrium sterni to the auricles of the heart.

What are the particular symptoms of Graves' disease which indicate a preponderate influence of the thymus? Eppinger, Garrè, von Haberer, Klose, Capelle, Bayer, van Noorden, Jr., and indeed almost every clinician who has familiarized himself with the literature would say it is the vagotonic symptoms. But do we know quite definitely what the vagotonic symptoms are? And in case they should be determined shall we be in a position to assert that the thymus is or is not alone responsible for them?

Naturally it will fall to the lot of the surgeon to discover which of the symptoms are dissipated by the removal of the thymus; but even when this has been ascertained the proof is not furnished that no other organ could have had a part directly or indirectly in their causation.

Let us consider, for example, the protrusion of the eyeball, a symptom which according to MacCallum and others may be caused by stimulation of the sympathetic. If it is true that this is a sympathicotonic symptom and if the thymus were activated solely by the autonomic system, the excision of this gland might not be expected to affect directly and promptly the exophthalmus. But as a matter of fact recession of the eyeball in at least one of von Haberer's cases was much more prompt than has perhaps ever been observed after strumectomy alone. The effect on the thyroid gland, particularly as to its vascularity, seems to have been quite as striking in von Haberer's experience; it must, however, be remembered that except in one case the combined operation was performed.

To discuss the grounds on which the various signs have been assigned to their special groups would carry us beyond the purpose of this paper. I might say, however, by way of illustration, a word with reference to the incomplete convergence of the eyes. This, the Möbius sign, is assigned to the sympathicotonic group. It was explained by the late Dr. Landström and his supporters as due to the contraction of the Müller-Landström muscle of the orbit which is supposed to be responsible for the protrusion of the eyeball and by the particular arrangement of its fibres to embarrass the action of the internal rectus. There are some, and especially certain countrymen of Landström, who do not consider the demonstration complete that the Müller-Landström muscle is responsible for the exophthalmus. Furthermore, as I have said, the eyeball may promptly recede after thymectomy, and with its recession the Möbius sign may vanish, which is contrary to what might have been expected of a sympathicotonic symptom after the excision of an organ activated chiefly by the autonomic or vagosympathetic system.

Surgeons the world over have learned from an experience which is now very large that the majority of patients afflicted with exophthalmic goitre may be relieved of their symptoms by strumectomy, but that in a certain percentage of the cases the cure may be incomplete even after resection of the greater part of both lobes of the thyroid gland (Halsted).

I have performed perhaps 650 operations upon about 500 patients with Graves' disease. A one-sided lobectomy, the operation ordinarily done, has resulted in an approximate cure in possibly 60 per cent of my cases, but in at least 25 per cent the patient has not been sufficiently relieved by a one-sided lobectomy to resume her full duties, and in certainly more than 60 per cent (possibly 70 or 80 per cent) there remain symptoms of overactivity of the thyroid or thymus or of both of these glands sufficiently pronounced to be detected by the expert clinician.

The results of my experience as regards the cure of Graves' disease by one-sided lobectomy are quite at variance with the views of other surgeons.

In some 47 cases in which the improvement was altogether unsatisfactory after the excision of one lobe the other was removed. Of particular interest to me has been the observation, which we have made several times, that definite improvement may not be observed until both lobes have been almost completely excised. In a number of cases—all of them severe—in which the preliminary ligation of three or four arteries plus a single lobectomy was followed by little or perhaps inappreciable benefit the symptoms vanished, almost magically, on the removal of the remaining lobe. I should explain, parenthetically, that I never excise the entire lobe; a small slice is always left posteriorly to protect the parathyroid glands, for the

reason that the chances are considerable that the other side may have to be operated upon. It is undoubtedly because surgeons have so universally confined their operations to the excision of one lobe plus, perhaps, the ligation of an artery of the other, that the results have not been better than they

RESULTS OF OPERATIONS FOR BASEDOW'S DISEASE[5]

Year	Authors	No. of cases	Cures %	Considerable improvement %	Sligh improvement %	No improvement %	Deaths %
1896	Schulz	20	90.0	....	....	5.0	5.0
1898	Wolf	9	....	66.5	....	....	22.5
	Helferich	6	66.6	16.7	....	....	....
1900	Reinbach (v. Mikulicz)	18	66.5	22.5	....	5.5	5.5
1902	Witmer (Krönlein)	23	40.9	36.2	9.2	9.2	9.2
	Th. Kocher	59	76.0	14.0	....	3.3	6.7
1903	Curtis	11	60.0	10.0	....	....	30.0
1904	Mayo	40	67.5	17.5	....	....	15.0
1905	Lessing (König)	8	50.2	....	37.3	....	12.5
	Hartley	21	87.5	....	....	....	12.5
1906	K. Schulze (Riedel)	50	72.0	12.0	....	2.0	14.0
	A. Kocher	167	93.7	....	....	....	6.3
1907	Itzina (Hildebrand)	7	85.7	....	....	14.3	....
	Mayo (only new cases)	136	78.2	19.6	....	....	2.2
	Landström	54	50.2	15.3	....	29.0	5.5
1908	Moses (Garrè)	28	16.9	41.6	24.9	12.5	4.1
	Klemm	32	93.2	....	3.4	3.4	....
	Th. Kocher	153	....	98.7	....	....	1.3
	MacCosh	22	14.5	72.7	8.2	4.6	4.6
1909	Hänel	21	38.1	42.8	....	....	....
1911	Sudeck	26	84.6	4.0	....	....	4.0
	Baruch	40	72.5	12.5	....	15.0	15.8
	v. Eiselsberg	44	61.4	34.1	....	4.0	....
	Enderlen	40	70.0	20.0	....	2.2	2.2
1912	Klose	61	75.5	9.8	....	1.6	13.1
	Weispfennig	30	60.0	6.6	....	23.3	10.0

are. And you will agree with me that it is rather absurd to conclude that if the excision of an arbitrary amount of a gland supposed to be chiefly responsible for the symptoms did not cure or relieve them it would be useless to remove more of the offending organ.

Now although all of the symptoms including the expohthalmus may be cured by strumectomy, the blood-picture may remain unchanged, at least

[5] Klose, Die Basedowsche Krankheit. Erg. d. Inn. Med. u. Kinderheilk. Band x, 1913.

for a considerable period. We have, for example, five cases in our wards at present whose mononucleosis is as great and in one of them greater than before operation. In one the four arteries have been tied and one lobe resected. In two both lobes have been excised, and in the fourth, a very serious case, the inferior arteries were first ligated, then the superior arteries; next the right lobe and then the left was resected. This patient's health has already been almost completely restored but the mononucleosis is 53 per cent (small mononuclears 34 per cent, large mononuclears 19 per cent), 4 per cent higher than on admission.[6]

Baruch, Sudeck, Klose, Melchoir, Lampé and Liesegang and others would seem to have brought proof from extensive clinical observations that the pathological blood changes in Basedow's disease remain uninfluenced by the excision of the thyroid gland.

Klose states it is universally conceded that all the symptoms of Graves' disease may disappear after thyroidectomy but that the disordered blood-picture is supposed to remain unchanged, and hence if we desire a haematological cure we must attack, surgically, the thymus. Another particular indication, according to Klose, for the excision or destruction of the thymus is the fact that in Graves' disease this gland is qualitatively and not merely quantitatively altered and may cause toxic as well as mechanical injury to the heart.

Borchardt a little more than a year ago reported [7] the result of his studies in the medical clinic of Lichtheim at Königsberg of the blood-picture in diseases of the endocrine glands. He examined 31 cases of Graves' disease, 10 of status thymicolymphaticus, five of simple goitre, 15 of myxoedema (two of his own, and 13 in the literature), 13 of disease of the hypophysis (three of his own, 10 in the literature), and five of Addison's disease (two of his own, three in the literature).

Borchardt found that in all diseases of the glands of internal secretion there was in the great majority of the cases an increase in the mononuclear cells, especially of the lymphocytes. There was leucopenia in about half of the cases, and approximately as often eosinophilia.

Since in all diseases of the thyroid, hypophysis and adrenals signs of status thymicolymphaticus were established he concludes that the changes in the blood-picture are to be assigned to a status lymphaticus.

[6] These and many other cases controvert the opinion of von Lier who regards a lymphocytosis of 40 per cent as a contraindication to operation.

[7] Borchardt, Ueber das Blutbild bei Erkrankungen der Drüsen mit Innerer Secretion und seine Beziehungen zum Status thymicolymphaticus. Deutsches Archiv f. klin. Med., Bd. 106, 1912.

My observations do not permit me to accept *in toto* the views of Klose, Borchardt and the many others who attribute the lymphocytosis to the thymus. Of the 47 or more cases above referred to, operated upon during the past 20 years, in which I found it necessary to remove both lobes of the thyroid gland in order to relieve sufficiently the symptoms, about one-half have returned within the past two years for examination. In all of these, with perhaps two or three exceptions, the blood-picture is approximately normal. Of particular interest are the findings in a case at present in the hospital operated upon two years ago (double thyroid lobectomy). This patient was so ill when first admitted to the hospital, that I debated for some days as to the advisability of performing a lobectomy without the preliminary ligation of arteries. Her symptoms were predominantly vagotonic but there were no signs of enlargement of the thymus. There was a mononucleosis of 53 per cent.

The improvement which followed the resection of one lobe being unsatisfactory, the remaining lobe was excised. The blood-picture was at the time only slightly altered by these operations although there was marked improvement in her general condition.

Now, after two years, she was returned to the hospital for examination. She is almost restored to health and is able to perform all of her laborious household duties. She complains particularly of a sense of pressure behind the manubrium to which she attributes in a measure her shortness of breath at times. Percussion and the X-ray now indicate definitely an enlarged thymus. The blood-picture is, however, normal (mononucleosis 30 per cent).

Another patient (Miss G. C.) has just come on for reexamination from Texas, in response to a telegram from me. A year ago when admitted to Dr. Barker's service in the hospital she was acutely and desperately ill and was promptly transferred to the surgical side. The thyroid arteries were ligated, two at a time, and then, one after the other, the thyroid lobes were resected. Vagotonic and sympathicotonic symptoms were about equally pronounced. There was extreme exophthalmus with all the eye-signs. Pulse 140-150; slight enlargement of the heart. Sweating, diarrhoea, nausea and vomiting, intestinal gas, bad dreams. Dyspnoea, vertigo and very severe muscular cramps. Mononucleosis 51 per cent. There was no evidence of thymus enlargement.

Now, after a year, she has gained greatly in weight, is, in fact, a little too fleshy. Her general health is fairly good and is gradually improving. But her condition is not satisfactory. Her pulse is 100-110, she suffers from dyspnoea on slight exertion, has very little energy and is greatly concerned

about the exophthalmus which is still a conspicuous disfigurement.[8] The blood-picture is, however, normal (mononuclears 28 per cent).

From the facts gleaned at the autopsy table, from experiments on animals and above all from the results following primary thymectomies we have convincing evidence that the thymus gland may play an important part in Graves' disease, and in some cases assume the title rôle. Some of the most puzzling features of the disease are made possible of interpretation by the discovery of the influence which the thymus may exert.

That the secretions of the two organs concerned in the production of the Basedow picture have a relationship there can be little doubt. The injections and implantations in animals made by Svehle, Bircher, Bayer, Basch and Gebele demonstrate conclusively that the thymus and thyroid possess in common certain fundamental physiological properties.

Antagonistic factors are also at work in the two glands, the presence of which is indicated sometimes directly and sometimes indirectly by the behavior of other organs. There are few in this audience [9] who are not familiar with the already famous experiments of Gudernatsch. To tadpoles equally developed, he fed to some the thymus of the calf, to others the thyroid of beeves. As a result of the thymus feeding the tadpoles increased greatly in size without differentiation or change in form. The creatures fed with thyroid promptly put forth arms and legs and otherwise rapidly took on the features of the frog. In the relation of the thymus and thyroid to the genital sphere and to the adrenals we find indications of a possible antagonism of some sort between the two glands. It is a well-attested fact that gravidity exercises a favorable influence upon the symptoms of Graves' disease. Basedow, himself, made this observation. This would seem to indicate that in pregnancy, in which unusual demands are made upon the thyroid, an excessive secretion from this gland can be utilized.

Between the thymus and ovaries there is experimental evidence of a possible functional antagonism. Thus Paton, Soli, Klose, Vogt and others have observed after thymectomy an increase in the weight of the ovaries, and according to Tandler and Gross there is abnormal persistence of the thymus in eunuchs.

Eppinger [10] relates of a case of Graves' disease of mild form in which immediately after castration toxic symptoms of threatening severity set in.

[8] May 26. Within the past two months the patient's thymus has been treated with radium and the X-ray. The improvement has been quite marvelous. The exophthalmus has almost entirely disappeared and the patient considers herself almost well.

[9] This was delivered as a Harvey Lecture in New York early in 1914.

[10] Eppinger: Die Basedowsche Krankheit. Handbuch d. Neurologie, Bd. iv, Specielle Neurologie, iii, p. 62.

He states that in the literature (reference not given) he has found a similar case. Of like significance probably is the fact that during the climacterium a mild may be converted into a severe form of Graves' disease.

Four or five years ago I was consulted in the North Carolina mountains by a native woman (Mrs. B.) who stated that for the previous six months she had been able to swallow nothing but liquids and for a week or more nothing but water. She was greatly emaciated and so weak that she could hardly stand. She was confident that the obstruction was just behind the "Adam's apple." The thyroid and cricoid cartilages were strikingly prominent, so much so that I confidently expected to feel a carcinomatous mass back of the larynx. I could feel nothing, however, except possibly an indefinite, soft mass of the presence of which I was not absolutely certain. She refused to come to the hospital, saying that she preferred to die at home. A year later I was surprised to find her robust and in perfect health. The difficulty in swallowing began to diminish soon after her visit to me, and in a month or two she was able to take food of all kinds as well as ever. The relief seemed to come quite promptly after the complete cessation of the menses. I concluded that a retrotracheal or retrooesophageal portion of thyroid had become enlarged during the climacterium.

As further evidence of an antagonism between the secretions of the ovaries and thymus we may mention the excessive lymphocytosis which has been observed by Klose to follow the injection of Basedow-thymus after oöphorectomy. Klose injected 5 c. c. of thymus juice expressed from the gland of a Basedow patient into a spayed bitch whose lymphocytes after castration had risen to 32 per cent. Immediately after the injection there developed symptoms of severe Basedow intoxication. Shortly before death, which occurred one hour after the injection, the lymphocyte percentage was 64.

In one of my dogs (No. 9) which for 16 months had been deprived of both thyroid lobes and all the parathyroids except a graft, Dr. MacCallum found complete absence of spermatogenesis. The testis as a whole was atrophic and spongy, but the interstitial cells of Leydig, although inconspicuous and perhaps somewhat degenerated, were still present in abundance.

What, then, is the relation of the thymus to the thyroid in Graves' disease? As stated by Capelle, the thymus can hardly be an "Erfolgsorgan" (a terminal apparatus), which enlarges simply in response to a stimulus from the specific gland. It is not merely antagonistic or compensatory (loose terms) to the thyroid, for if so its excision should be attended with an increase of the Basedow symptoms. These organs, have, however, some sort of reciprocal relation. The effect of excision of the thyroid upon the

thymus and of the latter upon the former organ has not been definitely determined.

In the dog (No. 9) just referred to, in which both of the thyroid lobes and all of the parathyroids had been excised, the thymus was carefully examined by Dr. MacCallum, who at that time could have had no knowledge of its possible importance in Graves' disease. His report is as follows:

"There is quite abundant thymus tissue. In the thymus there are some cysts, one of them quite large and lined by ciliated epithelium. Ciliated cavities of small size are found quite frequently through the tissue. I do not see any Hassall's bodies unless these might represent them. The thymus is not in the acme of its development, but has undergone a certain amount of atrophy."

Tatum found that the thymus of rabbits atrophied after excision of the thyroid.

As to the effect upon the thyroid of total excision of the thymus there is also uncertainty. The histological picture presented by the thyroid, seven months after total excision by Dr. McClure of my staff, and Dr. Park, Dr. Howland's assistant, of the thymus in a puppy, aet. three months, seems to be identical with that obtained by Matti and Klose, and interpreted by them as hyperplasia. On comparing the sections of the thyroids of Dr. McClure's dogs, of the control with that of the thymectomized animal, I should say that the changes in the latter indicate overactivity. These changes consist chiefly in entire disappearance of the colloid, and great increase in the height of the cells. The follicles are perhaps a little smaller in the hyperactive gland than in the control, and involutions are not conspicuous.

One can hardly be too cautious in assigning causes for the appearances found in one gland after excision of another, or in the remains of a gland after the resection of a part of the same. I am prompted to say this from experiences of my own, having particularly in mind our efforts to find the cause of the almost invariable hypertrophy of the thyroid in our dogs experimented upon 26 years ago and to explain its absence after identically the same experiments during the past two years.

The pigmentation which has so emphatically arrested our attention in certain cases of Graves' disease deserves, I think, greater consideration than it has hitherto been accorded.

Our interest in this symptom has vastly increased now that we believe, I may say know, that the thymus may be an important factor in the disease.

As to the frequency of the occurrence of abnormal discoloration of the skin the statements of the various authors do not agree. Sattler, who gives the matter full consideration in his classical work on the symptomatology

of Graves' disease, places it at 18 per cent. Kocher finds abnormal pigmentation of the skin once in eight cases; Friedrich Müller observed it in four out of five of the serious cases. Murray noticed a more or less pronounced pigmentation of the skin 42 times in a series of 180 cases. There are some who think that this symptom rarely occurs. I have observed it chiefly in the instances of severe and of long-standing disease, and on reviewing the histories of my patients am impressed with the fact, as it seems to me, that the pigmentation has been more frequent in the vagotonic type of the disease.

This observation accords with what might be expected from animal experimentation and from the relation which has been observed by pathologists and clinicians of the thymus to the adrenals in status thymicolymphaticus and in Addison's disease. Dr. Samuel J. Crowe, of my staff, finds as a result of careful search of the records of the pathological department of The Johns Hopkins Hospital that in all the cases of status thymicolymphaticus there is a note to the effect that the adrenals were atrophied, and that in Addison's disease hypertrophy of the thymus is almost invariably recorded.

Boignet and Calogero and Matzoukis found that excision of the adrenals was followed by hypertrophy of the thymus. Soli, Matti and, I think, Klose noted enlargement of the adrenals after thymectomy. Wastenson states that involution of the thymus may occur in consequence of the injection of the extract of the medulla and cortex of the adrenals. Possibly the extract of the medulla alone might have produced similar results, for Matti states that it is the medullary portion of the adrenals which hypertrophies in dogs deprived of the thymus gland.

Matti found, further, in his own laboratory an indirect confirmation of the above-mentioned experimental data in that two animals with strikingly pronounced thymus-hyperplasia following extirpation of the spleen showed an extraordinary diminution in the amount of adrenal-medulla. In this constant reaction between the thymus and adrenal glands depressor influences are espied.

Treatment.—Primary thymectomies uncomplicated by strumectomy, and secondary thymectomies in cases not sufficiently relieved by resection of both lobes of the thyroid would be the operations of choice for those searching for the essence of the Basedow thymus. The combined operation would be avoided by them as much as possible until it became more definitely known how profoundly and in what particulars the thymus may influence the disease. The excision of even a very small piece of either gland for microscopical examination, in the course of operation upon the other, might vitiate the experiment. For example, in our Case 2 (boy aet. 13) the resection of a portion of thymus hardly larger than one's thumb was followed by almost complete relief of the symptoms, including a return of the blood-

picture to normal—symptoms which would be considered thymo- rather than thyrotoxic.

We are debating what should be done in a case desperately ill in which there are reasons for believing that the thymus is enlarged. Should we first ligate the thyroid arteries at one or more operations or perform primarily a thymectomy?[11] The ligation of one and perhaps even of two arteries is less of a proceeding than the excision or resection of the thymus, but is it not possible that the removal of a part of the gland the more specifically responsible for the disease might be better withstood by the patient than an operation of less magnitude upon the other? In our Case 1, for example, the ligations of the inferior thyroid arteries were followed by very little reaction and by great improvement in the general condition of the patient. Would it not have been better, we are asking ourselves, to have performed a thymectomy with her primarily in this case, or in preference to the thyroid lobectomy which was done subsequent to the ligations? The patient, you will recall, died suddenly one day after the strumectomy. These are questions to which further experience must give the answer.

I may say that except in the instance reported (Case 1) we have had no death from a lobectomy which had been preceded by preliminary ligation of one or more of the thyroid arteries. And even in the case just cited I am inclined to think that death might not have occurred had I ligated the superior as well as the inferior vessels. I believe from my own experience that, disregarding for the moment the question of thymus resection, we have absolute proof of the advisability of ligating the thyroid arteries, as advised by Kocher, in the severest forms of Graves' disease, indeed in all cases where there seems to be the slightest ground for fear that the patient might not withstand the lobectomy. Most surgeons have abandoned or not practised preliminary ligation of the arteries, contending that the repeated operations are more troublesome to the surgeon, are unpopular with the patient and yield no better results. As to the last point I am sure they are mistaken; as to the weight to be attached to the other two, each must be his own judge.

From the point of view of the research worker the combined operation, thyroidectomy plus thymectomy, should, as I have said, not be done, but when having excised one lobe of the thyroid I have found myself actually confronted at the operating table with an enlarged thymus I have felt compelled for the patient's sake to resect it.

There is much reason for hope that radium and the Roentgen-ray may give us the solution of this question. The blood of Basedow patients who

[11] May 26, 1914. For the past two months we have been treating the thymus gland of selected cases of Graves' disease with the X-ray. The results will be reported later.

have been treated with the X-ray shows remarkably little mononucleosis (Klose). Klose, Arella, Heincke, Peters and others have shown that under the influence of the X-ray the thymus rapidly undergoes involution, an involution which is so extensive that Klose expressly warns against radiation of the thymus region in children. The relative absence of lymphocytosis in Basedow patients whose goitres have been treated with the X-ray is attributed by Klose to the influence of the rays upon the thymus. In a case referred to earlier in the lecture it was mentioned that two nodules, remains of the thyroid isthmus, vanished promptly after prolonged exposure of the thymus to 1300 mg. of radium. The gradual enlargement of these nodules had caused the patient great anxiety, and she was the first to notice that they had disappeared. Furthermore, she no longer experienced the feeling of oppression behind the sternum which had been a source of constant annoyance and occasionally of distress.

I have touched my subject only very lightly at some of the higher points. Hardly enough has been said even to make it clear that an enormous amount of work underlies the facts which we at present possess. It must be evident to everyone, however, that there reigns the greatest confusion on the subject of the function of the glands of internal secretion.

Fortunately the ardor for research on our globe is not diminished by the conviction that we are laboring in the wake of workers infinite in numbers on countless worlds who have carried their investigations millions of years beyond the stage reached by us, and are rapidly progressing towards an ultimate solution which may never be reached.

THE RESULTS OF THE X-RAY TREATMENT OF THE THYMUS GLAND IN GRAVES' DISEASE[1]

In an address before the New York Academy of Medicine last year (March 14, 1914), I called attention of American physicians to the fact that the thymus gland may play an important rôle in Graves' disease.[2]

My remarks tonight are intended as a continuation of the address referred to, which was published last August in The Johns Hopkins Hospital Bulletin. It may be assumed that very few of our audience this evening read the midsummer numbers of medical journals, and hence, in order to make intelligible the special facts which I desire to emphasize at this time, I shall make an occasional draft upon my previous paper.

Less than four and one-half years ago Meltzer[3] made the following cautious statement concerning the thymus gland:

"With our present knowledge of the importance of the other ductless glands we are hardly justified in assuming that the thymus is a worthless foetal remnant. But we have to acknowledge that as yet there are no reliable observations or experiments which indicate clearly that the thymus has a function in postuterine life."

My interest in the thymus was greatly stimulated by the report of Garrè in 1911, at the Fortieth Congress of the Deutsche Gesellschaft für Chirurgie, of a case in which he had primarily removed the thymus for the cure of Graves' disease. Although well aware of the fact that a persistent or revivified thymus had repeatedly been observed in Basedow, he was astonished to learn from the statistics obtained by his assistant, Dr. Capelle, that a thymus persistens hyperplastica had been found in 95 per cent of the fatal cases, whether death was due simply to the severity of the disease, or occurred during the operation, or within 24 hours after the strumectomy.

Selecting a florid example of Graves' disease for his experiment, he exsected the thymus without molesting the thyroid. The result in this, his first case, was as follows: "Clinically no definite influence on the struma, the

[1] Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 7, 1914.

(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1915, xxvi, 55-57.

[2] Harvey Lecture. The Significance of the Thymus Gland in Graves' Disease. March 14, 1914.

[3] Meltzer: Animal Experimentation in Relation to our Knowledge of Secretions, Especially Internal Secretions. Proc. of the Path. Soc. of Phila., 1910.

exophthalmos or the eye symptoms, but an unequivocal improvement in the general condition as expressed by the signal quieting of the heart's action, rapid increase in weight, and a complete regression of the Kocher blood-picture, the lymphocytes falling from 40 to 25 and then to 10 per cent." Professor Garrè gave to his assistant, Dr. Capelle, credit for the work and for the thought which led them both to these conclusions, which, he said, find essential support in the proof by Klose that in the thymus substance there is a heart poison. Aside from the special action of the thymus there exist certainly, said Garrè, important reciprocal relations between these two glands. Reasons for this view are given in my Harvey Lecture.

In the three and a half years which have elapsed since Professor Garrè's report, research work on the thymus, which already had been considerable, has assumed large proportions, and the interest of surgeons and also of physicians, particularly in Germany, Russia, Switzerland and Italy, in the possible part that the thymus may play in Graves' disease has been thoroughly aroused. I am hoping each day that there may appear from our country a contribution to the subject. Up to the present time I have seen no reference made to it in the American or English literature. Operative confirmation of the correctness of the view of Garrè and Capelle and, I should add, of Hart and Rehn and Klose and Sauerbruch and others, is given in two papers by von Haberer.[4] Most convincing is the report of Case 3 in von Haberer's first paper.[5]

For a fuller consideration of the operative side of the question, I must again refer you to my paper.

Tonight we are concerned simply with the results of the X-ray treatment of the thymus in Graves' disease. Rudberg, Aubertin and Bordet, Pigache and Bécleré, Arelle, Heincke, Peters, Klose and others have shown that under the influence of the X-ray the thymus rapidly undergoes involution, an involution which is so extensive that Klose expressly warns against radiation of the thymus region in children. Heeding this warning, I excised portions of the thymus in two cases of Graves' disease in children, fearing to submit them to the risk of the X-ray treatment. In my paper (pp. 231 and 232), to which for the sake of brevity I have had occasion to refer so frequently, a brief reference is made to the result which followed treatment by radium[6] of a patient upon whom in two stages a double thyroid lobec-

[4] von Haberer: Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1913, Bd. 27, S. 199; Arch. f. klin. Chir., 1914, Bd. 105, S. 296.

[5] An abstract of this case as it appears in the August number of the Bulletin was read by Dr. Halsted.

[6] The radium treatment was very kindly given to this patient by Dr. Burnam in the sanatorium of Dr. Kelly.

tomy had been performed about two years previously. The effect of this treatment was so astonishing that I promptly wrote and telegraphed to six selected patients, those in whom the improvement after double thyroid lobectomy had been particularly unsatisfactory, urging them to return to the hospital as soon as possible. All of these patients responded promptly to my call, one coming from as far as Texas, making a journey which required four days. I wish here to express my gratitude to these patients, and my indebtedness to Dr. Baetjer and to Dr. Waters who have given the X-ray treatments to these six cases of double lobectomy and indeed to all of my new and to many of my old patients with Graves' disease.

As nearly a year has passed since this treatment was first tested, I feel that we may now with considerable assurance speak of the results.

In the six cases in which after double lobectomy the result was unsatisfactory the X-ray treatment was begun in March, April, or May, 1914. The time elapsed between the surgical operations and the treatment by radiation was four and a half years (one case), three years (one case), two years (one case), one year (one case), 10 months (one case), six months (one case).

Four of these cases were so ill on admission that ligation of the thyroid arteries was done in two or more stages preliminary to the first lobectomy. In two cases the four arteries were tied before excision was ventured. All of the patients were greatly improved by the operations and from being bedridden and in a pitiful state were enabled to go about moderately and find some pleasure in existence. But in none was the result satisfactory to myself, although four of the six cases were more than content with the relief which they had obtained from the operations. In only one case was there perfectly definite retrosternal dullness and X-ray shadow.

In each case the result of the radiation was prompt and striking. The improvement was so great that without exception the patients expressed delight at the result. Two state that they are "perfectly well." Two young women, and the youngest of the six, who were greatly discouraged by the inadequate operative relief, have now, with occasional exceptions, a normal pulse, and enjoy life almost to the full; one, however, is still concerned about the incomplete subsidence of the exophthalmos, which was extreme, and the other is easily fatigued. Each of the cases presents features of special interest which I hope to record at some other time. For example, in one pigmentation and in two the yellow pasty hue of the skin disappeared after the X-ray treatment.

In two, pronounced eye signs were improved almost immediately.

In three, headache, which had been more or less constant, was the first symptom to vanish, and has not returned.

Asthenia, which was common to all the cases, has been particularly influenced.

In one, pronounced agoraphobia has seemingly been cured. This patient who formerly dreaded crossing a street now threads crowded thoroughfares without concern.

It is interesting to note that in no instance did the lobectomies fail ultimately to restore the blood-picture, to reduce the percentage of lymphocytes when this had been too high. This was hardly to have been expected in cases so definitely relieved by radiation of the thymus as to indicate persisting overactivity of this gland.

I quite agree with Professor Kocher and Dr. Albert Kocher that strumectomy in Graves' disease restores after a time the normal blood-picture and that, therefore, in case the thymus is responsible for the high lymphocytosis, excision of the thyroid must correct in this respect the overactivity of the former gland.

But the fact that after double lobectomy without adequate relief, radiation of the thymus was followed by great improvement would indicate that the thymus was still uncontrolled, and this being the case, suggests that the high lymphocytosis may not have been caused solely by the thymus.

Is it conceivable that the persistent cells of the complex thymus, those causing the symptoms which were relieved by roentgenization, may not be the ones which gave rise or give rise to the lymphocytosis; or that with the degeneration and waning power of the cells their ability to sustain the lymphocytosis may be lost while they may still be responsible for the unrelieved symptoms? On the other hand, can we be sure that there is not sufficient diffusion of the rays aimed at the thymus to affect the remains of the thyroid lobes? This suggestion is scouted by the radiologists.

I have in mind a case of double lobectomy in which a tiny fragment of the isthmus of the thyroid became greatly hypertrophied after the operations, and disappeared entirely 48 hours after treatment of the thymus by radium.

Of very special interest to me are the conclusions given by Dr. Albert Kocher in an admirable paper—Ueber Basedow'sche Krankheit und Thymus—which he presented at the meeting in Berlin last April of the Deutsche Gesellschaft für Chirurgie. Dr. Kocher's views have, undoubtedly, the endorsement of his father, Prof. Theodor Kocher.

They are as follows:

"Basedow's disease without hyperplasia of the thyroid gland has not as yet been proved at autopsy or by operation.

"On the other hand, a considerable number of typical Basedow cases, with all the characteristic symptoms, have been observed in which no histopathological alterations of the thymus was found.

"It is, however, remarkable that in quite a large number of the Basedow patients there is found a late hyperplasia or late involution of the thymus. We estimate the number of these, on the basis of clinical and anatomical findings, at 45 to 50 per cent of all Basedow cases.

"The thymus-hyperplasia is much more common in the young than in the old Basedow patients. The age of most frequent occurrence of thymus-hyperplasia does not correspond with that of the commonest age for Basedow.

"From the weight alone of the thymus no conclusion can be drawn as to the amount of thymus-parenchyma which may be present.

"In the great majority of cases of Basedow with combined thymus-hyperplasia there is only a moderate enlargement of the thymus (15 to 30 grams). It is rare to find in them a gland weighing 50 grams. Equally heavy thymus glands occur without Basedow.

"The histological examination of our Basedow-thymus glands by Pettavel as well as those of von Haberer has shown that, without exception, there has been a mixed hyperplasia of cortex and medulla, and that histologically no difference existed between the hyperplasia of childhood and that of Basedow.

"In 21.5 per cent of the Basedow-thymus glands there are definite signs of an age-involution with abnormal amount of parenchyma; in 14.2 per cent distinct indications of pathological involution with excessive parenchyma-mass.

"Thymus-hyperplasia is much more common in some regions than in others, also in certain families, in which it occurs with and without Basedow. The examinations which have hitherto been made, especially the anatomical, make it probable that we are dealing with a regionary family persistence, or late hyperplasia and late involution established upon a congenital or, if you will, constitutional base.

"Clinical observations suggest that, at least in certain instances, there supervenes with the Basedow a further hyperplasia or revival, a regeneration in other words, of thymus-parenchyma, which, with the cure of the Basedow for the most part disappears. That there is such a revivification or regeneration we can only surmise, for we have up to the present time no anatomical proof of it in man.

"Accordingly, hyperplasia of the thymus would be present, for the most part, before the Basedow and could not, therefore, be the direct cause of the disease, especially as we find the same hyperplasia present in individuals who have at no time in their lives suffered from Basedow.

"The cause of the thymus-hyperplasia might stand in direct relation to the hypoplasia of the medulla of the adrenals.

"In accordance with biological laws it is certainly rather to be assumed that an organ is congenitally hypoplastic and in consequence another hypertrophies, than that congenital hyperplasia of one organ is responsible for hypoplasia of another.

"Hypoplasia of the adrenal-medulla in Basedow's disease was first demonstrated on our material by Pettavel; it is found with and without thymus-hyperplasia. In Basedow there occurs a cellular hypertrophy in the hypoplastic suprarenal-medulla.

"Both of the changes, adrenal-hypoplasia and thymus-hyperplasia, remain latent in most cases until the onset of the Basedow, wherein, by the

altered function of the thyroid, there is called forth a disturbance in compensation.

"Up to the present moment it cannot be definitely said whether we may attribute certain of the symptoms of Basedow's disease to changes in the adrenals and the thymus, or whether we may do so only in certain cases.

"As proof that the adrenal-hypoplasia was present in latent form before the manifestation of Basedow we regard the appearance and disappearance of certain symptoms synchronously with the vanishing of the Basedow, symptoms which one observes in cases of atrophy of the adrenals without Basedow; we mention only the melanodermia of certain Basedow patients.

"Something similar may exist for the thymus-hyperplasia. We have, therefore, emphasized the above symptoms as occurring in Basedow with thymus.

"To this extent one can speak of a special action of the thymus and adrenals and of special symptoms attributable to the influence of these organs in Basedow's disease.

"For the view that a typical Basedow picture, without thyroid hyperplasia, can be evoked by the hyperplastic thymus we have up to the present moment no support.

"For the therapy of the cases of Basedow complicated with thymus-hyperplasia, the following conclusions present themselves:

"In these cases, also, the disease is recovered from by sufficient reduction of the hyperplastic thyroid, provided operation is not too long deferred. The thymus-hyperplasia then gradually regresses.

"The thyroid operation is in these cases not more dangerous than in the Basedow patients without thymus.

"Basedow with a high degree of thymus-hyperplasia, as is more frequently observed in younger individuals, is cured only by earliest possible operation upon the thyroid gland.

"In these cases, as also in those in which obdurate symptoms persist, and further when there is a tendency to recurrence, thymectomy may with advantage be added to the thyroid excision.

"The indication for thymectomy in Basedow's disease may be determined not only by the existence and severity of certain symptoms but also by the result of the test-administration of preparations of the thymus and thyroid glands. A preliminary treatment, before the thyroid operation, with thymus preparations and with Roentgen-radiation of the thymus is indicated in cases which react favorably to these procedures. Such treatment is, however, only temporary in its effect; especially is this true of the radiation, and it must therefore be undertaken only a short time prior to the operation upon the thyroid gland."

Dr. Kocher's opinion that the effect of the X-ray in cases of Graves' disease is transient might seem, at first thought, not to accord with our experience. But our views do not necessarily conflict. In Professor Kocher's clinic the roentgenization of the thymus was done before the strumectomy, whereas in our six cases of double lobectomy it was after the final operation upon the thyroid—in one case 4½ years thereafter. We believe with

Dr. Kocher that there is probably a regression of the hyperplasia of the thymus after strumectomy. Granting this, it is presumable that the roentgenization of a gland (the thymus) at a time when there is a continuous tendency to degenerate should be more effective and more permanent in its results than in the period of its greatest activity, particularly when this hyperactivity is being constantly sustained by the stimulation of another organ (the thyroid gland).

THE OPERATIVE STORY OF GOITRE

THE AUTHOR'S OPERATION[1a]

The extirpation of the thyroid gland for goitre typifies, perhaps better than any operation, the supreme triumph of the surgeon's art. A feat which today can be accomplished by any really competent operator without danger of mishap and which was conceived more than one thousand years ago might appear an unlikely competitor for a place in surgery so exalted.

There are operations today more delicate and, perhaps, more difficult, but they have followed naturally and easily in the paths made clear for them. But is there any operative problem propounded so long ago and attacked by so many which has cost so much thought and endeavor and so many lives before its ultimate solution was achieved? And further, is there any problem in surgery having required for its solution such intrepid throbbing and prolonged striving of the world's greatest surgeons which has yielded results so bountiful and so adequate?

For thousands of years, probably, goitre has been a familiar malady. An unsightly and frequently fatal disease, it was accepted as an inoperable affliction or dispensation of Providence in communities where it prevailed, and paraded the streets exciting the curiosity of the populace in towns where it was unusual. The sufferers sought relief from suffocation, difficulty in swallowing, failure of the heart and from a distressing disfigurement. Thus this conspicuous tumor of the neck was a perpetual challenge to the physician, and to the surgeon a stigma as well.

My interest in the thyroid gland may be traced to the time, 40 years ago, when Wölfler was writing his classic monograph on *Die Entwickelung und Bau des Kropfes.*[370] Anton Wölfler, first assistant of Billroth and later professor of surgery in Prague, occasionally came to the laboratory in which I was working in Vienna in 1879 and 1880 to study my sections of the salmon, with reference to the development and structure of the thyroid gland in the fish. I do not recall, however, having seen an operation for goitre in the clinic of Billroth, which I attended quite regularly.

From 1880 to 1886, the period of my surgical activities in New York, I neither saw nor heard of an operation for goitre, except that in one instance I assisted Dr. Henry B. Sands to extirpate a small tumor from the right lobe of the thyroid gland. The patient, a male, was operated upon

[1a] Johns Hopkins Hosp. Rep., Balt., 1920, xix, 71-257. (Reprinted.)

in the sitting posture, with a rubber bag to catch the blood tied about his neck. We had only two artery forceps, all, probably, that the hospital afforded, and these were of the mouse-tooth or bulldog variety (Liston's).

In the autumn of 1887, at the suggestion of Dr. Welch, I began experiments on extirpation and transplantation of the thyroid gland in dogs, which resulted in the discovery, among other things, of the striking histologic changes which signify hyperplasia and hyperactivity of this gland and which apparently are identical with those usually found in Graves' disease. The knowledge thus acquired enabled us early to interpret the microscopic picture of the gland of exophthalmic goitre. The remarkable discoveries by Gley (1891-2)[121] and Vassale and Generali (1896)[344] of the vital importance of the parathyroid glandules stimulated afresh my interest in the surgery of the thyroid gland and suggested experiments in transplantation of the tiny epithelial bodies (Epithelkörperchen). From these experiments there resulted the general law that homografts of these glandules will not live, and that for the successful transplantation of autografts a considerable deficiency must be created. We made the startling and hardly believable observation that the life of a dog may be maintained by a particle of parathyroid tissue only one-quarter of a millimetre in diameter and extinguished by tetany on its removal.

In 1907 Mr. Herbert M. Evans kindly made at my request arterial injections of the parathyroid glandules, and from his and Dr. W. G. MacCallum's careful anatomical studies and my own surgical and experimental observations there resulted an operative procedure in our clinic which I have described on several occasions (1907,[148, 149] 1911,[150] 1912[151]), but perhaps too fragmentarily to attract attention. Inasmuch as we have been unable during the past 12 years to make any essential improvements in our operation, it occurred to me that it might now be well to describe it in greater detail and to give in outline the history of the development of the operation for goitre.

So far as possible I have let the story narrate itself in the words of the principal actors, those chiefly responsible for the operative progress. Surgical performances which seem not to have influenced the development of the operation have been in greater part merely recorded.

I wish to express my thanks and deep indebtedness to Colonel McCulloch and Dr. Fielding Garrison for their great courtesy and assistance. They have granted me very unusual privileges in the use of the Surgeon General's Library, without which and the *Index Medicus* it would not have been possible to conduct the investigation.

To my accomplished secretaries, Miss Stokes and Miss Hough, I can hardly emphasize sufficiently the extent of my obligations for their assiduous and intelligent support. And in the beautifully executed illustrations

from the pencil of Max Broedel I have found constant pleasure and a stimulus.

Statistics on the subject of operations, performed the world over, for goitre have from time to time been compiled. The latest collection is Süskind's, who in 1877,[330] reporting 28 operations by Victor von Bruns of Tübingen, was able most favorably to compare his master's work with that of all others and justly to boast of the contributions which German-speaking nations had made to the list of operations for goitre as contrasted with those from the rest of the globe. He makes no mention of a very similar, but less fervidly patriotic paper by Bruberger[58] which antedated his own by about one year. The fundamental historical papers are a tract by Hedenus (Leipzig, 1822),[156] an admirable treatise by Mandt (1832)[232] of Greifswald, and a voluminous chapter by Günther (1864),[114] professor of surgery in Leipzig, in the fifth volume of his *Lehre von den blutigen Operationen am menschlichen Körper.*

HISTORICAL PAPERS

MANDT. *Der Kropf; Geschichte u. Exstirpation desselben,* Rust's Magazin f. d. gesammte Heilkunde, Berlin, 1832, vol. 37, pp. 390, 412, 413.

"The early story of goitre is voluminous, but very tangled. Traces of attempts to distinguish varieties are found with the ancients; later, however, and especially in the Middle Ages, scrofula and other diseases of the glands were confounded with it and synonymously treated. This error was continued until late in the eighteenth century.

"Only in recent, indeed very recent, times have the doctrines on the subject of goitre been put in order by the works of Kortum,[200] Wichman.[361] Webers (Monograph on Scrofula), Maas,[225] von Walther,[349] Hausleutner,[155] Mühlibach,[253] Hedenus,[156] especially Johannes Müller and others.

"I think it probable that Abul Casem Khalaf Ebn Abbas, usually named Albucasis, undertook about the year 330 * a genuine extirpation of goitre. He lived in Bagdad, was a bold and, one may say, venturesome operator, and could the better hazard the operation because of the following experience: A 'homo ignarus' had attempted a similar operation, and the patient hav-

* Gurlt (Geschichte d. Chirurgie, vol. i, p. 620) states: "The year of his (Albucasis') birth is unknown. Nevertheless, it is safe to say that he lived in the second half of the tenth century, since it is stated that he was the body physician of Caliph el-Hakim III (961-976). According to the latest investigations of Leclerc (Gaz. hebd. de méd. et de chir., 1874, pp. 537, 569) the statements of the Arab chroniclers that he died in the 404th year of the Hejira, or 1013 of the Christian era, can be accepted as correct (in spite of the assertion of Mich. Casiri, 1766, who says that Albucasis died almost 100 years later, *i. e.*, in the 500th year of the Hejira or 1106-7 A. D.). And if it is true, according to the account of Leo Africanus, that he lived to the age of 101 years, then he must have been born in the year 912 A. D." (W. S. H.)

ing nearly bled to death from an injured artery Albucasis knew very well how to control the haemorrhage by ligature and the hot iron."

G. B. Günther. In the fifth volume of that scholarly, voluminous, altogether remarkable and today almost unknown work, Günther's *Lehre von den blutigen Operationen am menschlichen Körper,* Leipzig, 1864, 5. Abtheilung, p. 369, the author records in chronological order abstracts of the first 41 cutting operations performed for the removal in whole or in part of "Struma lymphatica," the common form of goitre, covering the period from Celsus to 1861.

"We have used chiefly the treatise by Mandt in Greifswald, Rust's Magazin, vol. 37, p. 411, and that by Hedenus,* *Tractatus de gland. thyreoid.,* Lipsiae, 1822, and, at the same time, corrected some errors which appear in these articles.

"According to Schreger, Celsus had already undertaken the extirpation of goitre. But it is clear from the text that in the chapter which Celsus entitles 'De Struma,' lib. vii, cap. 13, the author, in the use of this term, has not in mind a disease of the thyroid gland, but rather a swelling of the lymph glands. Of goitre proper he speaks in lib. vii, cap. 13, under the title 'De Cervicis Vitio.' Here he describes, unmistakably, cystic goitre, and says, after discussing the use of caustics, 'sed scalpelli curatio brevior est.'

"It is doubtful if the operation mentioned by Galenus, 'De Locis Affectis' (lib. i, cap. 6), comes under this head. See Hedenus, *Tractatus de gland. thyreoid.,* Lipsiae, 1922, p. 288.

"According to Mandt in Rust's Magazin, vol. 37, p. 413; and Langenbeck, Chirurgie, v, p. 306 (note), Albucasis is listed among those who performed this operation about the year 330. In the local library I have not been able to find any passages bearing on this.

"Paulus Ægineta, who lived 400 years later, evidently refers, like Celsus, to tumors of the lymphatic glands when he speaks of amputating strumas. Guy de Chauliac (1363) advocated the extirpation of goitre instead of treatment by 'sympathetical' means.

"Extirpation is next mentioned by Johannes de Vigo (1501 to 1512).

"Mandt, in Rust's Magazin, vol. 34, p. 414, states that Amatus Lusitanus about the year 1550 relates that an 'audax homo' excised small goitres, and thereby exposed the trachea. I therefore consulted the 1557 edition of the works of this author and found only two passages which could be construed as bearing on the extirpation of goitres. One is found in Centur. III, Curatio 56, p. 416, and is entitled 'De Strumis'; the other, in Centur. IV, Curatio 58, p. 597, and is entitled 'De Strumis Dictis Scrofulosis.' But one soon becomes convinced that by the former he means scrofulous abscesses, and by the latter swollen lymph glands.

"It is doubtful whether the accounts of Fabricius ab Aquapendente (1613) and of Marchetti (1664) relate to an extirpated goitre or to swollen glands.

* Hedenus, Augustus Gulielm, not to be confounded with J. A. W. Hedenus whose operation for goitre is described later in this paper.

"Joh. Jessen speaks also of an operation on a bronchocele, but he certainly alludes to a swollen gland. Dionis, in his *Cours d'opérations de chirurgie,* 4th edition, 1740, p. 639, after describing struma lymphatica, gives explicit directions for operation. After reading his description of the operation, one doubts whether the author really performed it or only witnessed it.

"According to the account of Mandt, there is an observation by Muralt which makes it seem very probable that an extirpation was accomplished. The communications of Wepfer (1727) and Wiesemann probably relate only to the excision of lymphatic glands. I cannot find anything in Muralt and Wepfer bearing on this operation.

"On the contrary, Forestor, Fulvius Gherli (1710), Petit, Roonhuysen, Hoin, and Conrad Ludwig Walther seem to have excised true goitres. Mandt credits also Joseph Warner. In the translation of the fourth edition, 1787, pp. 83 and 84, I have found only two cases which could possibly be considered under this heading. After reading the full description of these cases I am convinced that they were not goitres.

"Laurentius Heister, 1752, seems to have performed the operation several times, for he says in the second edition of his large *Chirurgie,* vol. ii, p. 659, that he has never found it necessary to use the red-hot iron on account of bleeding. He also describes, in detail, the operative procedure.

"Theden, *Neue Bemerkungen und Erfahrungen, etc.,* new edition, 1776, vol. ii, p. 108, tells of an operation performed by an unnamed physician, with happy result. Mandt speaks of this as a successful case; but it appears that he did not read it in the original, or he could not have alluded to it as an extirpation of an ordinary goitre, for it was clearly a cystic goitre out of which a piece was cut. Desault erroneously credits Theden with an extirpation on account of this operation. It also appears that the case of Kaltschmied in Jena should not be counted among the extirpations. Theden says of this case that Kaltschmied had operated on a similar tumor of the gland, but that the carotid artery ran through it, that this artery was cut in two and that the patient died on the operating table.

"In the *Dissertation* of Zartmann, p. 5, it is stated that Schmucker removed a portion of a goitre. This statement is incorrect. In the second volume of his miscellaneous writings, from which Zartmann quotes, the 23d Observation is entitled: 'Complete Cure of an Enormous Goitre by Dr. Sellin, Military Surgeon' (the case, therefore, does not belong to Schmucker). The operative procedure was in no respect an extirpation; it consisted in the opening and stretching wide of abscesses, caused by severe inflammation of the goitre, whereby, to be sure, the entire enlarged thyroid gland, which contained many bony fragments, by degrees came away.

"Richter in Göttingen did not venture to undertake the operation.

"Boyer declared himself against it, and Fodéré claims to have carried it out only in cases of scirrhous degeneration.

"According to Froriep in Notizen, vol. vi, p. 336, the operation was practised in India.

"In the Dictionnaire des sciences médicales, vol. xviii, p. 555, several instances of extirpation of goitre are mentioned, but they certainly are not

all vouched for, and indeed in part are improbable. We quote the following from this treatise:

"'Fodéré asserts that this operation has been performed even by ignoramuses. It is known that intoxicated patients have cut out very large goitres without disaster; in other cases, they have accidentally been cut away without harm by the stroke of a sabre or a knife. Further, Paradin relates, "It is narrated in a chronicle of Savoyen that a barber successfully removed a disfiguring goitre from his wife." Fodéré tells of a courageous surgeon in Marseilles, Giraudy, who successfully removed two goitres.'"

Chronological List of All the Operations which Actually or in All Likelihood have been Performed

"1. In the year 1595 an empiric attempted to remove a goitre in the case of a 10-year-old girl. She died under the operation, and the surgeon was imprisoned. Fabric. Hildanus, vol. ii, p. 399; Fabric. Hildanus, Opera, p. 216, Obs. 35; Langenbeck, Chirurgie, Bd. v, p. 306, footnote.

"2. Johann Heinrich Freitag in Zürich, about 1694; *Epistola de glandulae thyreoideae, partim osseae, partim meliceridis formam referentis exstirpatione,* Lipsiae, 1778; Weiz, *Neue Auszüge aus Dissertationen für Wundärzte,* Bd. iv, p. 66; Langenbeck, Chirurgie, Bd. v, p. 304.

"In a girl of 18 years Freitag extirpated, with success, probably half the thyroid gland. The tumor was almost the size of a goose's egg and could easily be dislodged up to the sternocleido-muscle. A deeply situated vessel, thought to be the right thyroid artery, was ligated. Langenbeck doubts that it was the thyroid gland. The fact that it was so easily movable is suspicious.

"3 and 4. (About 1770.) Benjamin Gooch. S. Cooper, Dictionary, vol. i, p. 301; Bell, System of Surgery, vol. v, p. 525; Richter, Chir. Bibliothek., Bd. ii, Stück IV, p. 128; Langenbeck, Chirurgie, Bd. v, p. 305, footnote; Dictionnaire des sciences médicales, t. xviii, p. 555.

"In one case (3) such a severe haemorrhage occurred that the surgeon was obliged to stop in the middle of the operation. He was unable to control the haemorrhage by any means. The patient died eight days later. Gooch assisted at this operation.

"In the other case (4), after several fruitless attempts at ligation of the arteries, the severe haemorrhage was controlled by compression day and night during eight days by persons alternating with each other at the task. Gooch should have performed this operation, but he declined. It was performed by another skilled surgeon.

"5. Adolph Friedrich Vogel, in his inaugural dissertation (*Observationes quaedam chirurgicae*), Kiel, 1771, reports this operation, but he does not say who performed it. If he had performed it himself he would certainly have said so. Peculiarities in the procedure were the circular incision employed in removing the tumor, and the ligation of the arteries leading into the thyroid gland by a common ligature. I have compared the *Observat. quaedam chirurg.,* Killiae, 1771, quoted by Mandt, but have not been able to find this case.

"6. Desault excised successfully the greater part (so it is said in the text) of an enlarged thyroid gland in the year 1791.* Desault, Chir. Wahrnehmungen, 1794, Bd. v, p. 3. This is probably the case attributed to Girault by Bernstein (Handbuch der Chirurgie, Leipzig, 1800, Bd. iv, p. 604). There are many errors in Bernstein.

"7. Another operation which Desault performed on a woman is described in the Dictionnaire des sciences médicales, t. xviii, p. 356. After beginning the operation the haemorrhage was so severe that he abandoned the attempt and contented himself with tying up the piece of gland which had been cut. The patient died subsequently of convulsions.

"8. In the time of Desault. Related by Parey in Strasburg. Rullier, Dict. des sci. méd., t. xviii, p. 504; Rust's Chirurgie, Bd. xv, p. 504.

"In the case of Marquis A., Desault advised operation; Parey and Louis advised against it. The surgeon who had proposed the operation performed it with the assistance of two people whom he came across accidentally. The patient died from haemorrhage on the operating table.

"9. About 1800. Kergel, military surgeon of Saxony. Successful operation. He had to ligate 11 arteries. Bernstein Handbuch d. Chir., Leipzig, 1800, Bd. iv, p. 405; *ibid.*, 5. Aufl., 1818, Bd. i, p. 752; Langenbeck, Chirurgie, Bd. v, p. 305.

"10-15. J. A. W. Hedenus in Dresden (about 1800). Six times with good results.† Journ. von Walther und Graefe, Bd. ii, p. 236.

"16. Bonnet, surgeon in Clermont-Ferrand. Year unknown. Brun, *Dissertation inaugurale sur le goître,* 1815, p. 16; Dict. des sci. méd., t. xviii, p. 564; Rust's Handb. d. Chir., Bd. xv, p. 504. The patient died from haemorrhage.

"17. Ohle, Prof. der Chir. Academie in Dresden. Successful. Hedenus, *Tractatus de gland, thyreoid.,* 1822, p. 291.

"18. Weiss in Dresden, successful. Hedenus, *l. c.*

"19. Dupuytren,‡ Jan. 1, 1808. Pelletan, Clin. Chirurg., vol. i, p. 215. Death after 35 hours. Seventh Obs., Paris, 1810; Dict. des sci. méd., t. xviii, p. 557; Rust's Handb. der Chir., Bd. xv, p. 504. Related in greater detail; Dupuytren, Clinique chirurgicale, t. i, p. 215, Obs. 7, Paris, 1810. Adelaïde Michon, aet. 28. Jäger, Walther und Radius, Bd. vi, p. 548, give this case and case No. 33 of this article as one and the same, while the reference here given by Pelletan and the reference in case 33 taken from Froriep's Notizen is regarded as one and the same story. The two cases, to be sure, have many points in common, but the two operations were certainly performed in two entirely different periods.

"20. Langenbeck in Göttingen (year unknown). Langenbeck, Chirurgie, Bd. v, p. 303.

"Since Langenbeck in the very full chapter on 'Struma,' declares himself, on the whole, more against than in favor of the operation, and also gives only very general rules for the same, one would doubt that he had himself operated if he had not said explicitly in Anm. 3: 'At the extirpa-

* A complete report of this case is given under the chapter on France.

† Paper of Hedenus is abstracted in chapter on Germany.

‡ For abstract see chapter on France.

tion which I accomplished I found not the least difficulty in ligating the arteries.' I have not been able to find out anything about the result.

"21. 1820, Graefe in Berlin, Jan. 19th. Hedenus, *Tractatus de gland. thyreoidea,* Lipsiae, 1822, p. 276; Journ. von Walther und Graefe, Bd. ii, p. 388. He had some time previously ligated the thyroid artery and removed only the greater part of the gland. Fifty-three arteries were ligated. The result was good.

"22, 23. Graefe. Hedenus states (*l. c.,* p. 292) that besides the above-mentioned case, Graefe has twice performed the operation successfully.

"24. Eichenberg, a Swiss, extirpated the gland without excessive bleeding. It is, however, doubtful whether this was the thyroid gland, although he asserts that after the operation the larynx and the trachea were exposed. Epheremid. med. physic. germ. acad. Natur. curios., Dec. ii, Anm. v, p. 453; Langenbeck, Chirurgie, Bd. v, p. 304.

"25. Klein * in Stuttgart, Journ. von Graefe und Walther, Bd. i, p. 120, undertook the operation in a boy of 15 years (1815). The patient died directly after the operation.

"26. Klein. On p. 130 he tells of a second operation, but it is doubtful if he extirpated the thyroid gland. He had only three arteries to ligate. The patient lost his voice during the operation, and developed great difficulty in swallowing. These symptoms disappeared very slowly after the ligatures came away.

"27. Klein. The third operation was performed on a man aged 22 years (p. 133). A very severe haemorrhage occurred, but the patient recovered, nevertheless.

"28. Hermann Schmidt in Paderborn. Zartmann, *Dissertation,* p. 26.

"29. Roux. Took out half the gland. Death. *Ibid.*

"30. About 1829, Green, at St. Thomas' Hospital. Extirpation of the right lobe in Maria Gale, aet. 24, on May 22d. Death June 6th. The Lancet, No. 302; Froriep's Notizen, Bd. xxv, p. 95.

"31. May 21, 1829. Walther. Removed half the gland. Patient Catherine Nath, aet. 28. Recovery. Chir. Handwörterbuch von Walther, Jäg. u. Rad., Bd. ii, p. 542; Zartmann, *Dissertation,* p. 26.

"32. Aug. 11, 1829. Walther. Removed half the gland. Patient, Elsie Hartung, aet. 34. Recovery. Chir. Handwörterbuch von Walther, Jäg. u. Rad., Bd. ii, p. 542; Zartmann, *Dissertation,* p. 22.

"33. About 1831. Nov. 22d. Dupuytren. Froriep's Notizen, Bd. xxix, p. 141. Girl of 12 years. Death the next day at 3 a. m.

"34. About 1832. Mandt in Greifswald. Patient Charlotte Schneider, aet. 34. Recovery. Rust's Magazin, Bd. xxxvii, p. 387.

"35. About 1834. Professor Franke in Leipzig, with the assistance of Professor Bock. Verbal report.

"36.† March 26, 1835. Roux. Operated on Girard Gourvain, aet. 22. Forty-seven ligatures were applied. The operation lasted 1½ hours. Arch.

* For full account see chapter on Germany.

† Abstracted in chapter on France. Interesting because the patient was venesected while dying from result of haemorrhage at the operation. Venesection was not infrequently practised on exsanguinated patients.

géner., 1836; Schmidt's Jahrb., Bd. xi, p. 58. Detailed with full autopsy account; Oppenheim, Zeitschrift ii, p. 519. Short account. Death after two days.

" 37. 1844-1846. Reported by Madelung in Gotha. Probable Recovery. Aerztlicher Verein in Gotha, 1844-46; Schmidt's Jahrb., Bd. lvi, p. 279.

" 38. Bruns in Tübingen. Deutsche Klinik, 1859, p. 145, Fall 3. Gurlt, Jahresbericht von 1859, p. 186. Successful.

" 39, 40. About 1861. Züricher Krankenhaus. Struma lymphatica twice successfully extirpated. Deutsche Klinik, 1861, p. 167.

" 41. N. Pirogoff. Rapport médical d'un voyage en Caucase et St. Petersbourgh, 1849; Schmidt's Jahrbücher, Bd. lxvii, p. 117. In a girl of 17, with the administration of ether. The middle lobe was the size of a goose's egg and pressed on the trachea. Thirty arteries were ligated. Operation lasted half an hour. Result not stated.

" 42. R. V. A. Schmidt tells of the extirpation of a goitre in a horse with the écraseur. Cure. Reported by Falke in Jena. Schmidt's Jahrb., Bd. cix, p. 346."

Thus the story is carried by Günther to 1861. He collected 41 cases, but overlooked 65 (France, 17; Italy, 13; Great Britain, 12; United States, 8; Germany, 15), operated upon prior to this date, which are abstracted in our tables. Many of these cases were, however, published in journals to which Günther hardly could have had access; and some were merely ligations of thyroid arteries which Günther did not attempt to collate. Most important, perhaps, of the omitted cases are Nathan R. Smith's (1835)[323] and E. S. Cooper's (1860).[83] The operations prior to 1861 were chiefly resections of portions of the gland or enucleations of more or less circumscribed nodules or ligations of one or two thyroid arteries. There were, however, several remarkable lobectomies which will be considered later under the geographic headings.

Operations Prior to 1861 Not Tabulated by Günther

FRANCE

Nélaton: Bull. soc. anat. de Paris, s. 3, i, 100.

Blandin: Ferrus, Dict. de méd. ou répertoire gén. des sci. méd., Paris, 1836, 2e éd., xiv, 181.

Voisin: Gaz. méd. de Paris, 1836, s. 2, iv, 372.

Bach: Hirtz, Gaz. méd. de Paris, 1841, s. 2, ix, 9.

Rigal, R.: Bull. gén. de thérap., méd. et chir., Paris, 1841, xxi, 224.

Ballard: Arch. gén. de méd., Paris, 1846, s. 4, xi, 222.

Roux: Petit, Bull. soc. anat. de Paris, 1848, xxiii, 205.

Bégin: Bull. de l'acad. nat. de méd., Paris, 1849-50, xv, 1110.
Roux: *Ibid.*, p. 1106.
Sédillot: Three cases, *ibid.*, p. 1132.
Cabaret: Gaz. méd. de Paris, 1850, s. 3, v, 710 (communiqué par Dr. Velpeau).
Alquié: Annales cliniques de Montpellier, 1854, ii, 222. Also reported by Barbin, Thèse de Montp., 1854, p. 26.
Dunglas: Gaz. méd. de Paris, 1856, s. 3, xi, 129.
Chassaignac: Foucart, La France méd. et pharm., Paris, 1860, vii, 284.

ITALY

Marzuttini, G. B.: Bull. d. sc. med. di Bologna, 1846, s. 3, ix, 365.
Porta, L.: Delle malattie e delle operazioni delle ghiandola tiroidea, Milano, 1849. Articola II, Cura chirurgica, p. 135.
Ibid., p. 135.
Ibid., p. 136.
Ibid., p. 139.
Ibid., p. 149.
Ibid., p. 150.
Ibid., p. 151.
Ibid., p. 152.
Ibid., p. 153.
Ibid., p. 154.
Annali Universali di Medicina, 1850, cxxxvi, 5.
Rizzoli: Collezione delle memorie chirurgiche ed ostetriche, Bologna, 1869, i, 112. (Originally published by Rasi in Bull. d. sc. med. di Bologna, fasc. di Aprile, 1845.)

GREAT BRITAIN

Blizard, Sir Wm.: Burns, A., Observations on the surgical anatomy of the head and neck, Edinburgh, 1811, p. 202. From manuscript notes taken by Dr. Brown.
Coates, H.: Med. Chir. Trans., Lond., 1819, x, 312 (communicated by Mr. Astley Cooper).
Key: Lancet, Lond., 1824, ii, 358.
Earle, H.: Lond. Med. and Phys. Jour., 1826, lvi, 201.
Liston, R.: Lond. Med. Gaz., 1830, vi, 477.
Brodie: Lancet, Lond., 1832, ii, 314 and 479.

Liston, R.: Wilson, W. J. E., Brit. Ann. Med., Pharm., etc., 1837, i, 11.
Lancet, Lond. (1839-40), 1840, ii, 31.
Lancet, Lond., 1841, i, 691.
Lectures on the operations of surgery, with numerous additions by Thos. D. Mütter, Phila., 1846, 320.
Ibid., p. 321.
Cusack, S. A.: Dublin Hosp. Gaz., 1857, iv, 276.

UNITED STATES

Harris, C. (1807): Gross, S. D., A system of surgery, Phila., 1882, 6th ed., ii, 354.
Mott, V.: "Early in his professional life." *Ibid.*
Jameson, H. G.: Amer. Med. Recorder, Phila., 1822, v, 116.
Smith, N. R.: North Amer. Arch. Med. and Surg. Sci., Balto., 1835, ii, 309.
Hoyt, O.: Bost. Med. and Surg. Jour., 1847, xxxv, 297.
Otis, G. A.: Virginia Med. and Surg. Jour., Richmond, 1845, ii, 115.
Toland, H. H.: Pacific Med. and Surg. Jour., San Francisco, 1858, i, 53.
Cooper, E. S.: Cinc. Lancet and Observer, 1860, iii, 15.

GERMANY

v. Walther, Ph.: Neue Heilart des Kropfes durch die Unterbindung der oberen Schilddrüsenschlagadern, u. s. w., Sulzbach, 1817, 10.
Zang: Rust's Magazin f. d. ges. Heilk., Berlin, 1820, vii, 314.
v. Walther, Ph.: J. d. Chir. u. Augenh., Berlin, 1821, ii, 584.
Wedemeyer: Neue Bibliothek f. d. Chirurgie u. Ophthalmologie, C. J. Langenbeck, Göttingen, 1822, iii, 185.
Fritze, C.: Hedenus, A. G., Tractatus de glandula thyreoidea, Lipsiae, 1822, p. 256, footnote 612.
Chelius, M. J.: Heidelberger klin. Annalen, 1825, i, 208.
Dieffenbach, J. F.: Die Operative Chirurgie, Leipzig, 1848, ii, 331.
Schuh: Wien. med. Wochenschr., 1859, ix, 641, 657 (three cases); *ibid.*, 1860, x, 145.
Klein: Dissert., Tübingen, 1860, 30.
Meeh: Med. Corresp.-Bl. d. württemb. ärztl., Vereins, 1861 (four cases).

At this juncture we may, opportunely, quote the views, current at the time (the middle of the 19th century), of a few of the world's leading surgeons on the subject of operating for goitre.

ROBERT LISTON.* *Lectures on the operations of surgery, and on diseases and accidents requiring operations.* With numerous additions by Thomas D. Mütter, Philadelphia, 1846, p. 318.

"It has been proposed, again, to cut these tumors out, and some surgeons have ventured upon that, but the result has not been at all satisfactory. You could not cut the thyroid gland out of the living body in its sound condition without risking the death of the patient from haemorrhage; and when that body has become hypertrophied to an immense extent, and all the veins and arteries are enormously enlarged, you can easily understand what dangers may arise from any attempt of the kind. Look at the foregoing sketch, and think of the dangers that must encompass you on all sides, and you will pause before undertaking such a task as the extirpation of the thyroid body. It is a proceeding by no means to be thought of."

JOHANN FRIEDRICH DIEFFENBACH.† *Die Operation des Kropfes. Die Operative Chirurgie.* Leipzig, 1848, vol. ii, pp. 331 and 340.

"The operation for goitre is one of the most thankless, most perilous undertakings, which, if not altogether prohibited, should at least be restricted to certain varieties of the malady.

"If, now, we again review all that we know from the writings of authors concerning operations upon large, uniformly hard or indeed scirrhous goitres, we can only regard with tremulous aversion these foolhardy performances."

* Robert Liston (1794-1847) was a pupil of Sir William Blizard (in 1816), who was the first to ligate the superior thyroid artery (publication in 1811); he taught anatomy with Syme, his younger rival; was a member of the Council of the Royal College of Surgeons, F. R. C. S., 1841.

Obituary notice, London *Times*, Dec. 20, 1847 (Dictionary of National Biography): "Liston's claim to remembrance is based upon the marvellous dexterity with which he used the surgeon's knife, and upon the profound knowledge of anatomy which enabled him to operate successfully in cases from which other surgeons shrank. Living at a time immediately antecedent to the introduction of anaesthetics, he appears to have attained to a dexterity in the use of cutting instruments which had probably never been equalled, and which is unlikely to be surpassed. When chloroform was unknown it was of the utmost importance that surgical operations should be performed as rapidly as possible. Of Liston it is told that, when he amputated, the gleam of his knife was followed so instantaneously by the sound of sawing as to make the two actions appear almost simultaneous, and yet he perfected the method of amputating by flaps."

† "Die operation des Kropfes ist eine der undanksbarsten, lebensgefährlichsten, und wenn auch nicht ganz aus der operativen Chirurgie zu verbannen, doch nur auf gewisse Kropfarten zu beschränken.

"Wenn wir nun alles, was wir aus den Werken der Schriftsteller über die Operation grosser, gleichmässig harter, oder selbst scirrhöser Kröpfe wissen, nochmals überlicken, so müssen wir mit Schaudern an diese tollkühnen Unternehmungen denken."

Samuel D. Gross. *A system of surgery.* Philadelphia, 1866, 4th ed., vol. ii, p. 394.

"When the tumor resists our curative efforts, and endangers suffocation, it has been proposed to afford relief by extirpation; but the question arises, is such a procedure proper or justifiable? In a word, can the thyroid gland, when in a state of enlargement, be removed with a reasonable hope of saving the patient? Experience emphatically answers, no. This conclusion is not invalidated by the fact that the operation has, in a few instances, been successfully performed. By no means. It only proves that an undertaking may occasionally be accomplished under circumstances apparently the most desperate. What has once been effected may be effected again. But no sensible man will, on slight considerations, attempt to extirpate a goitrous thyroid gland. If a surgeon should be so adventurous or foolhardy as to undertake the enterprise, I shall not envy him his feelings while engaged in the performance of it, or after he has completed it, should he be so fortunate as to do this. Every step he takes will be environed with difficulty, every stroke of his knife will be followed by a torrent of blood, and lucky will it be for him if his victim live long enough to enable him to finish his horrid butchery. Should the patient survive the immediate effects of the operation, if thus it may be called, death will be almost certain to overtake him from secondary haemorrhage, or from inflammation of the cervical vessels, esophagus and respiratory organs. When the tumor is large, the wound is of frightful extent, involving all the most important and delicate structures of the neck, and rendering it altogether improbable, from the constant motion of the windpipe and esophagus, that much of it will unite by first intention. Thus, whether we view this operation in relation to the difficulties which must necessarily attend its execution, or with reference to the severity of the subsequent inflammation, it is equally deserving of rebuke and condemnation. No honest and sensible surgeon, it seems to me, would ever engage in it."

John E. Erichsen. *The science and art of surgery.* American edition. Philadelphia, 1873, vol. ii, p. 367.

"I have more than once been tempted to remove large, pendulous, pedunculated bronchoceles, but close examination has satisfied me in all cases that the pedicle of the tumor was so vascular, containing large arterial and venous branches, and so intimately connected with the sheath of the carotid, stretching under the sternomastoid, which was expanded over it, that no operation could be safely undertaken. In the event of its being thought desirable to operate, the better plan would be, after exposing the tumor by a straight incision, to enucleate it as much as possible with the handle of the scalpel, ligaturing carefully all the vessels divided as they were cut."

Th. Billroth. *Geschwülste der Schilddrüse.* Chirurgische Klinik, Zürich, 1860-67. Berlin, 1869, p. 179.

Billroth, in 1869, having performed 20 extirpation operations for goitre with eight deaths, writes:

"To him who has had little practice in these operations it can easily happen that he removes the entire half of the gland instead of merely the tumor, whereby the operation becomes very complicated and more dangerous. The extirpation of the entire gland is not so exceedingly difficult and can be accomplished without great bleeding; but whether human beings can survive it has not yet been determined."

The deaths following Billroth's operations were due to infection, only one patient dying of "collapse" (haemorrhage?).

The views of other surgeons will appear later in the pages devoted to their contributions.

Bruberger. *Ueber die Exstirpation des Kropfes, nebst einem geheilten Fall von Totalexstirpation einer grossen, mit breiter Basis aufsitzenden Struma hyperplastica und statistischen Bemerkungen.* D. militärärztl. Zeitschr., Berlin, 1876, Jahrg. 5, p. 447.

In 17 pages Bruberger condenses the story of the surgical treatment of goitre from 1785 to 1876. The important work of Günther he undoubtedly overlooked, as no mention is made of it. For the extirpations from 1785 to 1845 he accepts Brière's collation from Schmidt's Jahrbücher (*l. c.*). From 1845 to 1876 the study is original and possibly furnished to Süskind material for his monograph of the following year.

A very creditable and successful case of Küster's, which Bruberger publishes in detail, gave the incentive for his work. A "total extirpation" in a difficult case was performed by Küster in the Augusta Hospital, Berlin, on May 4, 1875. In January and May of the following year the patient was examined by Bruberger, who found him in perfect health and with voice unaffected. In the strict sense of the term this operation of Küster's was probably not a total extirpation, for I note that the broad base or pedicle of each lobe was perforated in several places and tied off in masses. Had no thyroid tissue been left to the patient it is more than likely that such a procedure would have caught the recurrent nerve and probably have cut off the circulation of the parathyroid glands. As there was neither tetany nor cachexia strumipriva nor laryngeal paralysis, it is probable that the patient (male, aet. 18) was not entirely deprived of his thyroid gland.

Bruberger tabulated 124 cases. In 82 it could not be determined that anything more than the "goitre" had been excised; of these patients, 28 died and 54 recovered.

"In 17 cases," he writes, "the entire degenerated gland was certainly removed; of these only two died. In 25 cases it is expressly stated by the authors that only degenerated portions were removed; of these, five died.

"The mortality from goitre-extirpations, according to the published reports, amounts to 29 per cent."

In Bruberger's table the 17 total extirpations are assigned as follows: Lücke, 2; Greene, 3; Watson, 6; Kocher, 2; Hopmann, 1; Michel, 1; Dupuytren, 1; Roux, 1.

By reference to the notes which we have made of these cases from the original sources I am convinced there is no evidence that the entire thyroid gland was removed in any one of them except Kocher's. Sick's [320] case is regarded by Bruberger as a partial extirpation. This is probably an error, for from Sick's description of the operation it seems quite certain that the entire gland was removed; furthermore, the patient developed symptoms of thyroid privation—*the first recorded case of status thyreoprivus.*

It would indeed be strange if 17 complete extirpations had been accomplished by the comparatively rough methods of the earlier, relatively inexperienced, surgeons without resultant tetany or cachexia strumipriva or injury to the recurrent nerve, when later operators with vastly greater experience and better technical equipment had such disastrous sequelae from their total excisions. Thus Kocher, in 1883,[102] states that of 18 patients, out of 34 with total excision who returned for examination, only two were free from the symptoms of cachexia strumipriva. In three of Mikulicz's total excisions (1886)[249] of the thyroid gland, tetany occurred; and in one of the cases of tetany, cachexia strumipriva developed later.

In 1883 Weiss [359] reported eight cases of tetany from Billroth's clinic; he does not, however, give the number of Billroth's total lobectomies at that time. But the previous year Wölfler [369] reported these as 22, with two postoperative deaths.

Notwithstanding much speculation on the subject by various authors, it has not been made clear why Kocher's cases of cachexia strumipriva should have been so free from tetany, nor why Billroth's total extirpations should have been so frequently followed by tetany and should have so seldom manifested symptoms of thyroid deprivation. I have pondered this question for many years and conclude that the explanation probably lies in the operative methods of the two illustrious surgeons. Kocher, neat and precise, operating in a relatively bloodless manner, scrupulously removed the entire thyroid gland, doing little damage outside of its capsule. Billroth, operating more rapidly and, as I recall his manner (1879 and 1880), with less regard for the tissues and less concern for haemorrhage, might easily have removed the parathyroids or at least have interfered with their blood supply, and have left fragments of the thyroid. Surprising, however, is the fact that the function of the parathyroids was so seldom interfered with by Kocher, notwithstanding his careful procedure; for these little bodies were entirely disregarded by surgeons until years after the discoveries of Gley (1891)[121] and Vassale and Generali (1896).[344]

Bruberger writes: "Besides Lücke, who, quite beyond question, ranks first as authority in the province of the surgical treatment of goitre, and

who as early as 1870 declared himself in favor of excision, there are several surgeons who, very recently, have rendered conspicuous service in matters pertaining to the technique of goitre-extirpation. These are the American Greene, the Englishman Watson, our German fellow-countryman Kocher and the Frenchman Michel. In the preceding pages I have furnished proof that the surgical authorities of all countries have almost up to the present time contributed to the placing of a ban upon the excision of goitre; it is therefore permissible to point out, in connection with the above names, that the voices which now are asking that this adverse verdict be set aside are from Germany, England, France and America, and, accordingly, that the reintroduction of goitre-extirpation as an operation which is justifiable and deserving of a place of honor has international support.

"Watson practises the following original method, which he has had opportunity to test in six cases: He divides the soft parts by a long incision in the midline, passes the index finger round the upper and lateral edge of the struma and carries a threaded aneurism-needle beneath the gland from the middle of the upper to the middle of the lateral edge. When this thread is tied, about one-fourth of the vessels leading into the gland are shut off. In the same way the needle is passed three times beneath the remaining quarters of the gland, and after all the threads are tied, the tumor is severed from its connections by means of curved scissors.

"Greene divides his procedure, which he has practised in three cases, into four operative acts: (1) Exposure of the struma by a long, straight incision, avoiding any wounding of the tumor or of its fascia; (2) division of the fascia of the tumor on the director; (3) retraction of the fascia and enucleation of the tumor with the fingers and the handle of the scalpel—disregarding the bleeding, the operator advances quickly to the base in order to compress the thyroid arteries; (4) transfixion and double ligation of the pedicle.

"Kocher, who has already reported 13 cases of goitre-extirpation—among them two cases of cure by total extirpation—practised in four cases the enucleation described by him."

Thus, with generous courtesy, Bruberger divides the honors of the early triumphs in the surgery of the thyroid gland almost equally between Germany, England, France and America, mentioning after Lücke, the name of one surgeon for each country—Kocher for Switzerland, Watson (Edinburgh) for England, Michel for France and Greene for America; and this, too, at a time when for Germany he might have mentioned, among many, the names of Hedenus, von Walther, von Bruns and Billroth, and probably could not from his knowledge have credited America with any one besides Greene, nor Great Britain with any one except Watson. The names of Desault, Dupuytren and Sédillot for France he should not have overlooked. Süskind, truer to the facts, waves ardently, a year later, the colors of his country.

Adolph Süskind. *Ueber die Exstirpation von Strumen.* Inaugural-Abhandlung, Tübingen, 1877.

Süskind continues the operative story introduced so comprehensively by the scholarly Günther and carried by him from the beginning of the Chris-

BRUBERGER'S STATISTICAL SUMMARY OF GOITRE-EXTIRPATIONS TO 1876

Operator	No. of cases	Cured	Died	Total extirpations of whole thyroid gland	Partial extirpations (whole gland not affected)	References
Operations, 1785-1845 ..	29	18	11	....	....	Schmidt's Jahrbücher, collected by Brière.
Walther	2	2	..	....	....	Zartmann: De Strumae exstirpat. Dissertation, Bonn.
Bruns	5	3	2	....	....	Werner: Chir. Behandl. d. Strumen. Dissert., Tübingen, 1853.
						Klein: Behandl. der Strumen. Dissert., Tübingen, 1860.
Emmert	3	2	1	....	3	Brière: Du traitement chirurgical des goitres parenchymateux. Lausanne, 1871. (Cases 10, 11, 12.)
Billroth	20	12	8	....	....	Billroth: Chir. Erfahr., Zürich, 1860-67.
Middeldorpf	1	1	..	....	....	Lebert: Krankh. d. Schilddrüse.
Schuh	4	4	..	....	....	Wien. med. Wochenschr., 1859, 60.
Lücke	9	8	1	2 (cured)	7 (1 death)	Lücke: Chir. Klinik in Bern, Brière, *l. c.*, Cases 1-9.
Greene	3	3	..	3	....	Amer. Journ. Med. Sci., Jan., 1871.
Watson	6	5	1	6 (1 death)	....	Edinb. Med. Journ., 1873, p. 252; Brit. Med. Journ., 1875, Sept. 25.
Kocher	13	11	2	2 (cured)	....	Methode d. Exstirpatio Strumae nebst Bericht über 13 Fälle. D. Zeitschr. f. Chir., Bd. iv.
Kappeler	5	5	..	....	....	Bericht aus dem Spital Münsterlingen, 1874.
Sick	1	1	..	....	1 (cured)	Württemb. med. Correspondbl., 1867, No. 25.
Hofmockl	2	1	1	....	2 (1 death)	Wiener med. Presse, 1869, No. 2, 3, u. 4.
Blackman	1	1	..	....	1	Amer. Journ. Med. Sci., 1870, Jan.
Hopmann	1	1	..	1	....	D. Zeitschr. f. Chir., 1872, Bd. ii.
Holmes	1	..	1	....	1	Amer. Journ. Med. Sci., Jan., 1873.
Billroth	3	2	1	....	3 (1 death)	Chir. Klinik in Wien, 1869 u. 70, p. 130.
Michel	1	1	..	1	....	This and the following cases are taken from a paper by Michel in which the cases in French literature are assembled.
Desault	2	1	1	....	2 (1 death)	
Dupuytren	2	0	2	1 (died)	1 (died)	
Roux	2	1	1	1 (cured)	1 (died)	Gaz. hebd., 1874, No. 44 et 45.
Sédillot	3	3	..	....	3	
Bégin	1	..	1	....	....	
Cabaret	1	1	..	....	....	
Blandin	1	1	..	....	....	
Brun	1	..	1	....	....	
Percy	1	..	1	....	....	
	124	88	36	17 (2 deaths)	25 (6 deaths)	

tian era to the middle of the 19th century. He makes no mention of Bruberger's paper of the preceding year.

The contrast between the adverse sentence visited by surgical authors with few exceptions upon extirpatio strumae and the favorable results obtained by Victor von Bruns in the surgical clinic at Tübingen gave Süskind the incentive to submit to critical review the cases theretofore published. For the history of the earlier period he makes due acknowledgment to the work of Günther (*l. c.*), and to Michel (1873)[246] for his collection of cases operated upon in France. Quite justly he makes the claim that from the end of the 18th century to the date of his thesis (1877) the operative work upon the thyroid gland pas performed chiefly by German surgeons. Notwithstanding this, the general verdict among them at the time of Süskind's publication was decidedly against these performances which in great measure had resulted disastrously.

Süskind writes:

"At the end of the 18th century when the operation was celebrating in Germany its first triumphs it was emphatically condemned in France * by all the members of the influential Academy of Surgeons of Paris except Desault,† who, according to Günther and Michel (*l. c.*), is the first French surgeon to whom is accredited the excision of a struma."

Süskind, evaluating operations upon the thyroid in terms of failure and success, writes:

"Günther in the above-cited work gives 37 cases of extirpation of solid strumas which, up to the middle of this century, he found recorded. Of these 37 cases, 17, nearly one-half, ran a fatal course. Gurlt in his monograph *Ueber die Cystengeschwülste des Halses* (Berlin, 1855) enumerates 10 cases of extirpation of cystic goitres, of which, as Klein has remarked in his dissertation, three should not be regarded as extirpations. There remain, accordingly, seven extirpations of cystic goitres, one with fatal result. The total number of extirpations up the year 1850 is 44; of these 18 ended fatally—mortality 40.9 per cent. Of the operations since this time (1850) there were performed

By Germans	97	extirpations with	20 deaths,
By Americans ‡	7	extirpations with	3 deaths,
By Englishmen	12	extirpations with	0 death,
By Frenchmen	2	extirpations with	0 death,

accordingly a mortality of 19.4 per cent.

* It was also condemned in Germany, by most surgeons, even three-quarters of a century later.

† Desault (*l. c.*) operated upon two cases—in one of them successfully (*vid.* Table I, France).

‡ Süskind's figures for England, France and America are far from complete. By reference to my tables it will be seen that up to 1877 there had been in America 30 operations with five deaths; in England 39, with nine deaths; and in France 30, with 10 deaths.

"Of the various operators, Bruns has extirpated the greate
strumas:

Bruns	28, with 6 deaths,
Billroth	20, with 8 deaths,
Kocher	13, with 2 deaths,
Kapeller	5, with 0 death,
Chelius	5, with 1 death,
Meeh	4, with 0 death.

"Comparing the mortality figures of the extirpations made before and after the middle of this century, we find:

"1. That the mortality from the operation in the past 25 years has decreased by one-half.

"2. That the extirpation of strumas is not only not more dangerous than other major surgical procedures, but indeed offers greater chances of success than many dangerous, but nevertheless approved, operations, such as high amputations of the thigh, resection of the hipjoint, exarticulation of entire limbs, ovariotomy.

"As far as I have been able to discover, the following are the cases * of extirpation of goitre which have been published since the middle of this century:

"To begin with, Werner recorded in 1853, in his dissertation written under the presidency of Professor von Bruns (*Ueber die chirurgischen Behandlung von Strumen*), a successful case operated on by Professor Bruns, describing at the same time the customary procedure followed in the Tübingen surgical clinic, in which were employed all possible precautions against haemorrhage in this operation.

"To this case are added the following, according to date of publication:

"1859	3	cases by Schuh in Vienna (Wien. med. Wochenschrift, 1859, pp. 641 and 657).
"1860	1	case by Schuh (Wien. med. Wochenschrift, 1860, p. 145).
	3	cases by Bruns in Tübingen (dissertation by Klein: *Beitrag zur chir. Behandlung der Strumen,* 1860).
	1	case of extirpation, begun but not completed, is not counted.
"1861	4	cases by Meeh in Brackenheim (Med. Corr.-Bl. für württemb. ärztl. Ver., 1861, Nr. 29).
"1862	1	case by Middeldorpf in Breslau (*cf.* Lebert, *Krankheiten der Schilddrüse,* p. 221).
"1867	1	case by Sick in Stuttgart (Med. Corr.-Bl. für württemb. ärztl. Ver., 1867, Nr. 25).
	1	case by Gärtner in Stuttgart (Med. Corr.-Bl. für württemb. ärztl. Ver., 1867, Nr. 40).
"1868	20	cases by Billroth, at that time in Zürich (Billroth, Chir. Klinik in Zürich, 1860-67).
"1871	9	cases by Lücke, at that time in Bern (*cf.* dissertation by Brière: *Du traitement des goîtres parenchymateux et en particulier de leur extirpation,* Lausanne, 1871).
	3	cases by Emmert in Bern (*ibid.*).

* In Germany, Switzerland and Austria

ses by Kappeler in Münsterlingen (*Chir. Beobachtungen aus dem Thurgau'schen Cantonsspital Münsterlingen,* 1865-70).

" 1874 1 case by Hopmann in Cologne (Deutsche Zeitschrift für Chirurgie, Bd. ii).

5 cases by Chelius in Dresden (*cf.* Jahresbericht der Gesellschaft für Natur- und Heilkunde in Dresden, Oct., 1873, Mai, 1874).

" 1875 13 cases by Kocher, at that time in Bern (*cf.* Deutsche Zeitschrift für Chirurgie, Bd. iv).

2 cases by Gärtner in Stuttgart (Med. Corr.-Bl. für württemb. ärztl. Ver., 1875, Nr. 29).

" 1876 1 case by Gärtner in Stuttgart (Med. Corr.-Bl. für württemb. ärztl. Ver., 1876, Nr. 3).

"In addition to the 70 cases in the German literature published since the middle of this century, 23 other cases of goitre extirpations should be added. These patients were operated on by Professor von Bruns between 1861 and 1876 in the Tübingen surgical clinic. I propose to assemble these cases, together with the remaining cases of goitre extirpation made since the middle of this century (as far as I have been able to find accurate description in the literature available to me) in a tabulated review, and then to run over them for the results of the operation (mortality, dangers and indications), and describe in more detail the operative technique, especially that customarily employed at the Bruns clinic.

"In closing I shall add some especially instructive clinical histories from the Tübingen clinic.

"Upon the whole it appears that the good results obtained in late years by good operative methods only now entitle this operation to assume the place of honor in surgery which was earlier altogether forfeited on account of mishaps caused by imperfect technique." *

I shall leave unconsidered the attempts, continued in some countries until after 1890, to reduce the size of goitres by the use of the setaceum, wick, hair seton, cannula, incision, through drainage; by the injection of iodine, tincture of chloride of iron, turpentine, etc.; by caustics and by the actual cautery; by subcutaneous and, indeed, extracutaneous ligature *en masse* of thyroid tumors or prominent goitrous nodules; by débridement, subcutane Zerreissung (Billroth), morcellement, évidement (Kocher), etc.; and shall confine myself to the story of operations performed with the scalpel.

In our tables of operations performed in France, Italy, Great Britain and the United States up to 1883, the year when the operation may be considered to have become essentially perfected in Switzerland, Germany and Austria, there are included a number of the earlier and more important ligations of arteries. Counting these, the score of each of the four great nations is about 50 (France, 53; Italy, 53; Great Britain, 49; United States, 45).

* Süskind had in mind merely the technique of operating, the art of controlling haemorrhage—not the antiseptic technique.

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tissue, due to the pressure exercised by the growing adenoma, a new capsule develops. This capsule may contain all that remains of the original thyroid lobe, although usually normal glandular tissue is found at the upper pole. Adenomata may be deeply buried in the thyroid, surrounded everywhere by normal or even occasionally, as in Graves' disease, by hyperplastic glandular tissue. The capsule of an adenoma may, therefore, consist solely of connective tissue or almost altogether of thyroid gland.

Many a surgeon, on enucleation of an adenoma, has believed, undoubtedly, that he had performed a lobectomy, inasmuch as no vestige of the thyroid gland remained at the conclusion of the operation. He may, however, merely have enucleated an adenoma from its transformed, transfigured capsule, and nevertheless have thought or found it necessary to ligate both thyroid arteries.

It is impossible to decide from Giraud's description of Desault's operation whether or not there were remnants of normal thyroid tissue in the part removed. In any event, the operation was a remarkable one for his time.

There are cases, but these are not common, in which no trace of the thyroid lobe remains to suggest that the adenoma had originally been embedded in glandular tissue. The tumor in these cases is delivered more easily at operation than a thyroid lobe would be, and is enclosed in an extrinsic capsule thicker than that which ordinarily envelopes the gland. But the blood supply is quite different and less abundant.

"In 1784, Jacqueline Hyons, then 20 years of age, experienced a very sharp pain in the anterior and middle part of her neck, following a violent movement of the head. Although this pain was but momentary, there remained afterwards slight restriction of movement; but three months later there appeared to the right of the trachea a small, hard, indolent tumor, without fever and without change in the color of the skin. Over it were felt lifting pulsations which showed that it was situated over a large artery; in fact, its base rested on the ordinary course of the common carotid.

"The patient, who was not at all incommoded by the tumor, paid no attention to it until June, 1788. At that time the tumor measured 1 inch in diameter, and thenceforth its progress became as rapid as it had previously been slow. Internal and external remedies had no effect upon the progress of the tumor; there was always manifest a fluctuation in the centre. On making an incision at this point there issued a yellowish serosity. Three months after this operation, which was absolutely fruitless, caustic was applied several times, also without result. At last the patient, having suffered in vain for a long time, presented herself at the Hôtel Dieu in Paris, on May 20, 1791.

"At this period the tumor was 2 inches in diameter; it was round, very hard, adherent to the right side and centre of the trachea, and pressed outwards the sternomastoid muscle. Besides being lifted up distinctly by each pulsation of the arteries, as has already been noted, it followed the movements of deglutition, and interfered a little with the passage of solid food.

"The patient, strongly desirous of being freed from this uncomfortable deformity, determined on the spot to undergo extirpation of the tumor, which was suggested to her as the sole expedient; but we did not conceal from her either the dangers, the length of the operation or the pain which were inseparable from the procedure. M. Desault performed this operation in the amphitheatre, after having for several days prepared this woman by general remedies.

"The patient was put on her back, inclined a little to the left side, the head and neck elevated more than the rest of the body. The surgeon made a longitudinal incision over the centre of the tumor extending it a finger's breadth above and a finger's breadth below it, in order to facilitate the carrying out of the operation. With this first incision he penetrated to the gland, dividing the skin, the cutaneous muscle and some fibres of the sterno-hyoid and thyroid muscles. Then, while an assistant drew to the left the internal border of the incision, in order to immobilize the tumor, he separated it from the sternomastoid muscle. In cutting the cellular tissue surrounding these parts he divided two small arteries, which he immediately ligated while they were lifted up by means of a dissecting forceps. Then, after having disengaged the external side of the tumor, the internal side was likewise freed by drawing the tumor outwards with a hook in order to facilitate its separation from the anterior part and from the side of the trachea. In the course of this dissection the branches of the thyroid arteries were successively ligated as they were cut. Then the assistant who held the hook drew the gland inward and forward, and at the same time the operator completed its dissection exteriorly, above and below. This phase of the dissection was most minute and difficult. It was necessary to sponge continually the small quantity of blood which still oozed and prevented one from recognizing clearly the tissues. This it was which made it necessary to cut only a little at a time and to identify with the finger, before each cut of the bistouri, the part which was about to be incised. Dissecting with these precautions, the superior and inferior thyroid arteries were exposed without wounding them, and were ligated with the aid of a blunt-curved needle. These arteries were divided transversely and it was found possible to detach the tumor from the trachea, to which it was firmly adherent.

"The wound resulting from this operation was almost 3 inches deep; it was bounded exteriorly by the sternomastoid muscle, within by the trachea and the esophagus, and behind by the common carotid artery and the eighth pair of nerves, which appeared at the bottom of the wound.

"After having washed this wound with tepid water and having absorbed all the blood which it contained, it was filled with coarse lint powdered with colophony. Square compresses held in place by loosely applied bandages formed the rest of the dressing.

"The tumor after its excision was about 5 inches in circumference. However, it did not differ at all from other scirrhous glands, unless one notes the fact that it contained a cartilaginous nucleus.

"The patient had borne the long, difficult and painful operation with uncommon fortitude. She passed the rest of the day quietly, suffering only the pains usually present in large wounds. The following night she com-

plained of slight feeling of heat in the neck and of slight difficulty in swallowing. She was a little relieved the next day by soaking the dressing with a decoction of mallow. For a drink weak eau de chiendent seasoned with oximel was prescribed.

"The difficulty in swallowing greatly increased on the third day, although the fever was very moderate. At this period the compresses and the external lint were renewed for the first time, and the dressing was soaked as on the previous day.

"The fever ceased after the fourth day and the swallowing became less difficult. Suppuration had already begun: the following day it had detached all the lint so that the dressing could be entirely renewed. The wound was in good condition and it was dressed only with soft lint and compresses soaked in the emollient decoction. This was continued every day.

"Nothing of note happened in the course of the treatment. The wound followed the ordinary course of wounds. It had cicatrized at the end of a month, and the patient left the hospital perfectly recovered on the 34th day after the operation."

Desault's second case (No. 3), evidently much more difficult (no details given) than the first, ended disastrously. The dissection had hardly begun when blood flowed with such appalling violence that the operator was "obliged to give up the pursuit of his object." He transfixed the incised portion of the goitre with many threads, but the patient died in spasms.

Guillaume Dupuytren. (No. 4.) *L'excision de la thyroïde.* Related by Rullier in Dict. d. sci. méd., Paris, 1817, t. xviii, p. 557.

There are many dramatic, tragic and a few even brutal performances linked in the story of operations for goitre. One of the most pathetic cases is Dupuytren's first—reluctantly, conscientiously and courageously undertaken; cautiously, deliberately and admirably performed. Rullier draws the picture in stirring lines:

"Patient, female, aet. 28, was of a choleric and vivacious temperament; a worker in the fields, who had always enjoyed flourishing health.

"Eight years ago, following an attack of the itch which had been driven in by cold, the patient noticed a small tumor the size of a hazelnut on the anterior and middle part of her neck. From that time the tumor constantly increased in size, but its growth, slow and gradual at first, became very rapid in the course of the seventh year. Then it made enormous progress, and covered the whole front of the neck. Like the thyroid gland, of which it was only an expansion, the tumor presented three distinct lobes, one middle and two lateral; but the first alone became offensive. It fell in front of the sternum, presenting a tumor about 4 inches in diameter.

"At this period a surgeon of Paris, at the solicitation of this young woman, determined to excise the middle lobe. He succeeded in this after making a transverse incision of the teguments. No haemorrhage or other accident occurred, and the wound which resulted from this operation was healed at the end of a month.

"Meanwhile, about six months after this operation, the two lateral portions of this goitre acquired an enormous volume, the centre itself increased rapidly, and the whole formed a tumor so extensive that respiration became difficult. This difficulty in breathing increased towards evening and when the patient lay on her back. There was also difficulty in swallowing if the food was not very well masticated. Added to this marked derangement of function was such great deformity that this woman, still young and endowed by nature with a pleasant face and good figure, was distressed to be only an object of aversion and disgust to those around her.

"It was under these circumstances that the patient presented herself at the public service of the Hôtel Dieu. She wanted to be freed from the tumor, and she declared that whatever the dangers and pain to which she might be exposed, she was determined to submit to them. Nevertheless, in spite of her resolution, she received a negative answer, and was sent away by Drs. Pelletan and Dupuytren, who told her very positively that in their judgment she should not be operated upon. In spite of this she returned a few days later in the same state of mind but received the same answer; and all the dangers to which she would be exposed by operation were depicted to her in the most vivid colors. Besides, she was advised of appropriate measures to bring about the relief of the numerous symptoms of which she complained.

"However, nothing could convince this poor girl. She returned dissatisfied and desperate. Neither fear of the pain nor of the dangers to which she was incessantly warned she would expose herself, nor the express refusals which she had already received had any influence upon her spirit, and she did not hesitate to present herself for the third time at the Hôtel Dieu. Such perseverance at last vanquished our reluctance to admit her, and she entered the hospital January 1, 1808.

"Without, then, any fixed plan as to what might be determined to do for her, the surgeons of the hospital submitted to serious and thorough consideration the question as to what might appear best to attempt in behalf of this young woman.

"The picture which she presented at that time was as follows: Over the whole extent of the anterior and lateral regions of the neck there was a tumor extending vertically from the base of the inferior maxilla to the sternum and to the clavicles, and laterally, from one maxillary angle to the other. This tumor measured 7 inches longitudinally, and a little more transversely; one saw, as is usual in the thyroid, two distinct lateral lobes, connected with each other by a middle lobe, which was less protuberant and shorter in the vertical measurement than either of the other two. In addition, all three were irregularly nodular and soft to the touch. Their mobility differed: the middle lobe was very adherent to the larynx and moved only with it, while the two lateral lobes, loosely attached to the neighboring parts, could easily be moved in all directions. The teguments played freely over the portions of the tumor covered by them.

"The jugular veins and their ramifications were greatly dilated; the superior thyroid arteries, beating forcibly, could be palpated a little above the mid-portion of the tumor. The pulsations of the common carotids were likewise readily felt, but it was necessary to seek for them behind and outside

of the tumor, into which position they had been forced. The tumor itself had never become painful, but it hindered respiration to a very appreciable degree, interfered with deglutition, and under many circumstances, notably during strong emotion, it became a cause of obstruction to the circulation of the brain; at such time the patient's face for some instants would be deep red and she would be sensible or dazzling and vertigo. Otherwise all her functions were normal.

"Such was this affection, to which one could not give too serious attention; the progress which it had made for some time past, and was making each day, the imminent danger of suffocation to which it subjected the patient, did not admit of doubt that there would soon be a fatal issue. But when, on the other hand, one considered the location, the size and the relations of this tumor, one could not contemplate without well-founded fears the hazardous operation by which one might radically deliver the patient from this tumor. Nevertheless, the dangers overbalanced too much the advantages which one might expect from the operation, and it was determined to do nothing; but at that time a sombre despair took possession of the unhappy patient, her profound melancholy increased, and she resolved to let herself die of inanition. Indeed, she refused food of any kind. The menstrual flow which took place at that time, was suppressed, and soon thereafter a condition of violent spasm, extreme suffocation and convulsive movements came to augment the torment and the horror of the situation.

"This paramount circumstance put an end to our indecision; the patient would certainly perish, and there was some hope that she might be saved by operation. Operation was promised her, and calm returned to her spirit.

"The good health, the vigor, the youth of this girl, her extreme desire to be operated upon, and, moreover, the great mobility of the tumor, the laxity of its connection with the teguments, and, in short, the knowledge of what had been accomplished with impunity for a part of the tumor gave M. Dupuytren ground for the hope which determined him at last to risk the hazards of this operation.

"Observe how the operation, at which we assisted, was performed in the presence of M. Pelletan, of many surgeons of Paris, and of an immense gathering of students.

"The teguments of the anterior and middle part of the neck were elevated in such a manner as to form of them a transverse fold of great size. This fold was incised perpendicularly from over its centre to its base; the incision was then enlarged by carrying it upwards to the symphysis of the chin, and below to the superior border of the sternum. The left edge of the incision was detached by breaking up the cellular adhesions which connected it with the corresponding portion of the tumor, then the dissection was continued on the same side by lifting up the teguments and separating them from the tumor. Thus was reached the left part of the tumor. One encountered along this course two sets of veins, one of which was adherent to the tumor, and the other of which was subcutaneous. The greater part of these veins was avoided, and as to those which one was obliged to divide, not one was cut until two ligatures had been thrown round it: one on the side towards the heart, and the other on the side towards the tumor. Meanwhile, having reached the left side and behind this part, four thyroid arteries were

encountered, all of which appeared considerably dilated. They were easily recognized, and in ligating them the same precautions were observed as in the case of the veins; that is to say, that after having previously exposed them, two ligatures were passed around each, and they were cut in the space between these two ligatures.

"Here, as throughout the operation, *one was careful to place the first ligature on the side corresponding to the brain, in order to avoid prolongation of the pain which, without this precaution, would follow the application of the second ligature.** The same care was taken in the dissection, so that almost never were the arteries opened before being ligated, and always in a manner equally secure, whatever their size.

"One thus succeeded in detaching the left lobe of the tumor, without other accident to the patient than the pain inevitable in a dissection too careful not to become at the same time a little long. Soon afterwards the right part of the tumor was encountered, and it was separated from its surroundings with the same precautions and with equal success. During this stage of the operation we encountered no intimate adhesions which had to be destroyed; the fingers and the back of the bistouri sufficed almost always. It was easy also to avoid the internal jugular veins, the common carotid arteries and the pneumogastric nerves. Twenty times one perceived these parts, but they were always pushed away, and in this manner put, without trouble, out of danger.

"It was after this stage of the operation that M. Dupuytren saw the possibility of realizing the hope which he had conceived of removing the whole of the disease. In order to achieve this end the two lateral lobes of the tumor, which had just been successively isolated, were brought out again and through the skin incision; they were held in place by elevating them and carrying them a little forward, in order to stretch, in this way, the middle part of the tumor which adhered intimately to the larynx and to the windpipe; one succeeded in this manner in the dissection of this part, but it was done only by carrying the instrument down to the very substance of the gland, extremely close, it is true, to the larynx and the trachea, so dense was the cellular tissue which established the connection of these parts. The larynx and the trachea then appeared bare. The latter presented anteriorly a very marked flattening, evidence of the prolonged compression to which it had been subjected by the tumor.

"The patient bore with astonishing courage this operation, which was long, and which called for, during a dissection made in the midst of parts which it was important to avoid, sustained and delicate attention as much on the part of the surgeon as of his aids. Never for an instant, however, did one feel fear of a haemorrhage, and the patient did not lose more than a few spoonfuls of blood; but she was several times threatened with syncope, and she was also nauseated at times.

"The wound was dressed very gently; a little lint was put at the bottom and the edges were brought together fairly well; the sheaf formed by the threads of the ligature was brought to the inferior angle of the wound.

* Italics mine (W. S. H.). It is interesting to find this early reference to the sensitiveness of arteries.

"After the operation the face of the patient was very pale and profoundly altered; all of her vital forces were depressed; the pulse was frequent, small and concentrated; respiration was laborious and frequent, the skin quite uniformly cold; there was cardialgia and continued nausea. This unhappy woman, in a word, appeared to us to be dangerously stricken, and as if shocked by the blow itself of the operation.

"The most pressing indication to be met then appeared to be to raise again and to sustain the little strength left to the patient. Cordials were administered, but with great difficulty, because deglutition was much hampered, and one only lessened the dangers of suffocation, which appeared when the patient took a spoonful of liquid, by making her assume an almost vertical position.

"Nevertheless, from the same evening her unfavorable condition appeared to improve: to the prostration there succeeded a rather marked reaction, the pulse became frequent and high (élevé), the respiration deviated less from the normal state, color returned to the face, the skin was dry and warm, and some spoonfuls of liquid were administered without exciting nausea and vomiting. But the hopes raised by this improvement lasted a very short time, and from the fall of night the respiration became laborious, even stertorous, the pulse wretched, the skin without heat; in a word, the phenomena of the death-struggles commenced, and the patient expired the next day, 35 hours after the operation.

"Specially charged with the anatomic examination, this is what we observed in the tumor, the wound of the neck and in the remainder of the cadaver.

"The tumor which had formed the goitre was oblong, nodular, with a volume as great as that of the lungs of a young child. It presented two conoid lobes, excessively swollen. These lobes were joined together by a transverse mass, situated at their inferior and middle portion. A cellular mesh covered the whole surface of this tumor and was intimately adherent to it.

"This tumor was of a density which did not appear to be greater than that ordinarily seen in the thyroid; its weight, at the moment of extirpation, was 1202 gm., or about 2 pounds 8 ounces; its color was reddish, and its tissue was not different internally from that of the thyroid in its usual state: only the organization of this portion had become more evident by means of the considerable increase in nutrition which it had experienced. Here one perceived a multitude of small vesicular cysts, filled with a yellowish and viscous fluid; but besides, one saw here and there some points, whitish and callous, which appeared as if scirrhous. The superior and inferior thyroid arteries, as well as the thyroid veins, showed a diameter double their usual size. One may see the model in wax of this specimen in the anatomic museum of the Faculté de Médecine, where M. Dupuytren deposited it. . . . ."

Dupuytren practised the method of ligating twice and cutting between ligatures. This method has been attributed by Sick and others to Victor von Bruns. Dupuytren, in ligating arteries, placed the first ligature on the cerebral side so that patients would not twice suffer pain. I have often practised this method in local anaesthesia operations, believing it to be original; but Dupuytren had the idea 100 years ago.

Dupuytren removed the entire gland in bloodless manner—"only a few spoonfuls lost." Dupuytren like Desault accomplished the feat of dissecting the isthmus from the trachea, which more than one-half a century later even the greatest German and Swiss surgeons did not believe possible.

Dupuytren waited 11 years before venturing upon a second operation (Table I, No. 6). The goitre in this case, to his disappointment, had a broad, nonpedunculated base. Haemorrhage from many veins was controlled temporarily by finger pressure, but the patient was in syncope at the end of the operation. Thus, Dupuytren who had so calmly operated upon a relatively simple case was unable to contend with a complicated one.

Roux. (No. 9.) Reported by Rufz. *De l'extirpation d'un goître.* Arch. gén. de méd., Paris, 1836, s. 2, t. x, p. 25.

A brief abstract of Roux's case (No. 9) is here given to tell of a venesection performed just after an operation from which the patient had nearly bled to death on the table. Exsanguinated patients were venesected, sometimes repeatedly, to reduce the fever of sepsis.

The patient was a young peasant, aet. 22, with a large goitre in the centre of the neck, presenting two definite lobes. It was irregularly round, with nodules. The symptoms from the goitre were moderately severe.

Operation, March 26, 1835.—First incision in the mid-line from the hyoid bone to the sternum; second incision through the middle of the tumor from right to left. The tumor was freed partly by incision, partly by enucleation in three parts. The arteries were situated laterally, and could be for the most part ligated before being cut. Several veins were ligated. In all 40 to 47 ligatures were applied. The patient lost about "$1\frac{1}{2}$ pounds" of blood. The operation lasted 1 hour and 10 minutes. At 3 o'clock the lips were colorless. *The patient was bled, 6 ounces of blood being removed.** Death at 6 o'clock.

Ollier. (No. 35.) *Goître kystique ayant donné lieu à la triade du goître exophthalmique. Opération par les caustiques. Guérison de tous les symptômes.* Reported by A. Boursier. *L'intervention chirurgicale dans les tumeurs du corps thyroïde.* Thèse de Paris, 1880, Obs. ii, p. 172.

In 1877 Ollier cured by repeated incisions and cauterization a "cystic goitre," the size of a turkey's egg, which had caused pronounced symptoms of Graves' disease—pulse 160, exophthalmus, loss of flesh, etc. Two years later the patient's pulse was 80 and only a little exophthalmus remained. This case is not included in Buschan's collection (1894)[68] of 80 operations in Basedow cases.

Paul-Jules Tillaux. (Nos. 41, 47, 48.) *Sarcome du corps thyroïde ayant donné lieu à tous les symptômes du goître exophthalmique. Ablation*

* Italics mine (W. S. H.).

de la tumeur par M. Tillaux. Guérison de tous les accidents. Reported by Benard. *Contribution à l'étude du goître exophthalmique. Pathogénie. Traitement.* Thèse de Paris, 1882, Obs. ii, p. 36.

Tillaux operated upon two cases of hyperthyroidism (1880 and 1881). In both the toxic symptoms vanished.

In the second of these cases the tumor, believed on microscopic examination to be sarcoma, was circumscribed and confined to the left lobe; the right lobe and isthmus being "unaltered" were not removed. The clinical history, the operation and the thorough microscopical examination are admirably reported by Benard. This second case of Tillaux's is, I think, altogether the most interesting of the contributions of France to the surgery of the thyroid gland.

No. 47. Cazabonne, male, aet. 33, entered l'Hôpital Beaujean May 9, 1881. Four years previously he had noticed transitory disturbances of vision, with sometimes phenomena of cephalic congestion with headache and amblyopia. The patient also suffered with palpitation, especially after fast walking or mounting the stairs. He said that he had always had this symptom since childhood. One year previous to examination the patient noticed that his neck was enlarging. Iodine treatment had no effect. Two months after noticing the enlargement of his neck, the patient's eyes, which were naturally a little sunken, became prominent. As the exophthalmus increased the palpitation became exaggerated. Respiration also became more difficult. Attacks of suffocation occurred in the day as well as at night, and were accompanied by profuse perspiration of the head and upper part of the body. At the Beaujean, digitalis was administered. The palpitations diminished a little, but the voice became rough.

Examination, May 9, 1881: The largest part of the tumor is situated on the anterior lateral surface of the left side. There is a continuation on the right side, but much less voluminous, and appearing to be clearly separated from the tumor by the right sternomastoid. The anterior and left portions are, on the contrary, blended, and represent in their entirety a regularly rounded tumor. The lower border completely covers the sternoclavicular articulations and, a little, the sternal notch. The upper border runs obliquely upward and from right to left, passing 1 cm. below the Adam's apple; its left extremity reaching the angle of the jaw, about 4 cm. higher than in front on the midline. The left border reaches to the trapezius and forms a rounded and rather thick swelling. On the right the tumor stops beneath the sternomastoid. This portion on the right is a little soft, in contrast to the firmness of the rest of the tumor. Measurements: Vertically, 12 cm. in front, 14 cm. near the left border; 28 cm. transversely. For some years the neck measured 39 cm.: on examination it measures 47 cm. in circumference.

The skin moves easily on the tumor. On the right side the pulsations of the carotid seem weak, as if the artery were at a distance; on the left they are strong; and on palpation of the tumor there is the sensation of a veritable thrill, while it is at the same time evidently elevated by the immedi-

ately underlying vessel. Pressure on the right sternomastoid provokes a raucous cough with a prickling sensation in the larynx. The thyroid cartilage is thrown nearly 3 cm. to the right of the midline. The tumor does not appear to be very adherent to the larynx, but does seem to be rather solidly fixed to the surrounding muscles.

The surface of the tumor is rather regularly rounded without any prominent indentations. The consistency is firm; below and in front there is a zone where it is a little more soft, but there is no real fluctuation. One can see no movement of lifting up; palpation reveals no movement of expansion; one finds only near the left upper angle the pulsations of a superficial artery of rather large size. If the patient walks one perceives throbbing over the whole tumor, due to the exaggerated pulsations of the left carotid, which, lying immediately behind the tumor, lifts it up *en masse*. Auscultation reveals no true vascular bruit in the tumor, but the throbbing of the carotids is perceived over its whole extent.

Symptoms: Attacks of suffocation, due partly to compression of the trachea and partly to compression of the recurrents; rough voice, difficulty in swallowing. The two globes of the eyes are on the same plane and they reach the level of the orbital arcades. The patient estimates their projection in front at 1.5 cm. The eyelids close only with an effort; the sclera are visible around the cornea. There is continually a sense of tension in the eyes. There is diplopia when looking at objects at a distance. Movements of the eyes are easy and regular. Pupils normal.

On palpation the cardiac pulsations are rather strong, but there is no exaggerated thrill with the patient in repose; after walking, the pulsations become more frequent and the precordial impulse much stronger. Pulse 80; much quicker if the patient takes a few steps. Auscultation of the vessels of the neck shows continuous bruit with paroxysm. Appetite is good; no diarrhoea.

The patient has become irritable, flies into temper over nothing, is almost always in a state of very pronounced nervous agitation. There are frequently choreiform movements in the limbs.

Diagnosis: Exophthalmic goitre, as plain as possible.

On the left temple, the dorsal region (left side), and on the upper external part of the left arm are three small swellings about the size of a hazelnut. The patient noticed them about eight months before examination.

It was decided to operate May 18, 1881, and the patient was prepared and administration of the chloroform had begun, when he was seized with very severe attacks of dyspnoea, with harsh breathing and beginning cyanosis. On this account the operation was postponed and Dr. Tillaux decided to consult the Society of Surgery.

Benard writes: "The question of anaesthesia, decided in advance, so to speak, held small part in the discussion. It was decided not to use chloroform, but to have recourse simply to the administration of strong doses of chloral at the same time with subcutaneous injections of morphine.

"As to the expediency of surgical intervention, there was diversity of opinion.

"MM. Verneuil, Trélat, Duplay advised against operation, as much because of the immediate danger of the operation as of the probable hypothesis, according to M. Duplay, that the goitre might be the effect instead of a cause.

"MM. Labbé, Maurice, Perrin, Desprès, on the contrary, considering the condition of the patient who appeared doomed to certain and early death if left to himself, and being of the opinion that the surgeon should have the courage to undertake, at the risk of disagreeable eventualities, dangerous operations when they are the only chance offered to the patient, urged strongly M. Tillaux to persist in his first intention."

Operation, May 21, 1881.—The operation was begun at 9.30 a. m., about one hour after administration of morphine and chloral. U-shaped incision, with the opening above. The two lateral incisions were parallel with the anterior border of the sternomastoids. The horizontal incision, over the inferior third of the tumor, joined the others in rounding very slightly and giving to the flap an almost rectangular form. The right branch corresponded exactly to the right border of the tumor; the transverse incision was made next (both with the bistouri); for the left incision scissors were used and the teguments were divided from below upward. Here the haemorrhage was almost insignificant and was easily controlled with forceps.

After dissecting the cutaneous flap with the fingers for 8 or 10 cm., he cut the sternohyoids and omohyoids at the transverse incision. Now was seen the greater part of the tumor surrounded by the capsule. The operator proposed to disengage first the inferior border of the tumor by using on it from below upward a "mouvement de bascule" and to end on each side by ligature of the thyroid vessels. With the fingers bent he commenced the enucleation. But hardly had he freed the inferior border when the capsule tore and the pressure brought forth numerous fragments of a friable, granular mass, of grayish-white color, without any cohesion. This suddenly diminished the size of the tumor; then as much with the fingers as with the spatula he set himself to dissecting the remains of the capsule, having care to cut, at the same time, between two ligatures all the frena of vascular appearance which he encountered.

New difficulties presented themselves when it was necessary to attack the left extremity of the capsule, which reached deeply beneath and behind the sternomastoid. It was necessary above all to avoid the common carotid and the jugular vein which adhered firmly to the capsule. An assistant retroverted the cul-de-sac of this capsule, which was then completely detached with the spatula from the vessels. The rather firm adhesions to the upper part of the trachea were seized with a T-forceps and divided. Now the capsule adhered only to tissue of glandular appearance, representing the isthmus of the thyroid, the right lobe of which did not seem to be altered.

This species of pedicle was cut after being ligated. Then the extirpation of the tumor was complete, but below, behind the sternum, there was a deep cul-de-sac filled with débris.

"Having removed this, one was able to estimate the depth of the cul-de-sac which ran towards the mediastinum; with each expiration was seen the trunk of the left innominate vein, which was of enormous size and filled up the whole space. Above, one saw the trachea thrown to the left and considerably flattened transversely. Its right lateral face was hidden by the corresponding lobe of the thyroid body and had not been uncovered; the left face, on the contrary, running almost directly from in front backward, was

completely denuded and separated from the vasculo-nervous bundle by a rather large space into which reached a prolongation of the tumor.

"At the bottom of this space the whole anterior surface of the esophagus was seen, which was immediately in connection with the tumor; but the recurrent nerve had not been exposed."

All this part of the operation was effected in half an hour; but the wound was the site of haemorrhage which was controlled by means of a large number of ligatures, taking one hour.

When haemostasis was complete the wound was sutured and a drain placed in the lower part of the wound. Lister dressing; the patient was carried to a specially prepared carbolized room.

"From the first cut of the knife to the end of the dressing a 'pulvérisateur' enveloped the patient in carbolized vapors. The ligatures were of catgut. The Lister method was, in a word, scrupulously observed."

Post operation, May 22, 1881.—Since yesterday the patient has not suffered. He breathes easily. Dressing changed. May 25, 1881: Cough tires patient. Deglutition and respiration easy. Tension of the eyes diminishes more and more, and the patient says that the skin of his lids seems too long. Exophthalmus still rather prononunced. Palpitations have ceased. Temperature between 39° and 40°. May 28, 1881: Diminution of exophthalmus is apparent to any one. The wound continues to be satisfactory. Sutures removed. Healing *p. p.* At this point the recovery was complicated by an attack of erysipelas. June 20: From this late recovery from erysipelas.

July 8, 1881: Patient discharged. Exophthalmus has completely disappeared, but the patient is extremely thin and weak. There is trouble in the lungs. "It is probable that this organ (lungs) is the seat of generalized cancer, from which the patient will soon succumb." The patient died July 27, 1881.

Histological examination of the tumor: "It is easily determined that it belongs to the genus sarcoma but it presents diverse varieties of this kind of tumor.

"At certain points the tissue consists solely of fusiform cells, without appreciable intercellular substance, arranged in bundles which, grouped, present themselves as cut sometimes transversely, sometimes longitudinally (sarcome fasciculé).

"At other points true connective tissue fibres and trabeculae are seen between the cellular fasciculi (fibro-sarcome). Finally, one sees at these fibrosarcomatous points a homogeneous, faintly tinted and, in places, slightly granular intercellular substance imbedding the cells of certain bundles.

"The fusiform cells remain in relation with each other by prolongations more or less numerous. In a word, veritable mucous tissue is formed, not at all an extraordinary fact in a fibrosarcoma, this tumor belonging to the same class as the myxoma; *i. e.*, to the tumors derived from connective tissue.

"The vessels are not very numerous; for the most part they present a simple wall which, in the sarcomatous points, is not clearly distinct from the surrounding tissue.

". . . . fibrosarcoma, having become 'sarcome fasciculé' at certain points, and presenting myxomatous transformation in other regions much less extensive."

How is this case to be interpreted? That the patient was suffering from hyperthyroidism and that after removal of the tumor all the toxic symptoms, including the exophthalmus disappeared, there seems to be no doubt. The tumor was a circumscribed one of the left lobe. The right lobe and isthmus were, according to Tillaux, macroscopically normal. Could the new growth have been a sarcoma, as Tillaux supposed, and as the careful histologic examination by an accomplished pathologist seemed to indicate? Is it conceivable that a mesodermic tumor could, *per se,* be responsible for the syndrome of Graves' disease? Had the removal of the tumor not been followed by disappearance of the symptoms we might have surmised that the remaining right lobe and isthmus were hyperplastic and not, as Tillaux believed, normal. We are forced to the conclusion that the tumor must have been epithelial, either an adenoma or carcinoma, and not sarcomatous. An adenoma may, we know, cause severe thyroid intoxication, and Tillaux's description of the macroscopic appearance of the material eventrated, in the course of the operation, from within the capsule would not exclude this variety of tumor—nor, indeed, would the metastases to the temple, arm and lung necessarily exclude it. But a carcinoma of the thyroid might bear a closer resemblance, histologically, to sarcoma than would an adenoma.

Professor Kocher called my attention to the fact that Professor Langhans, his life-long friend in Bern, who, probably, studied malignant tumors of the thyroid more zealously than any one, had finally concluded that certain malignant tumors of this gland, which for many years he had considered sarcomata (indeed spindle-celled sarcomata), were undoubtedly carcinomata. If Langhans was for a time so deceived, surely others may well have been. But it would not altogether clarify the situation to assume that Tillaux's tumor was a carcinoma, for carcinomata of the thyroid have rarely been accompanied by the symptoms of hyperthyroidism, and then only in a very mild form. Adenomata, on the other hand, may produce the complete picture of Graves' disease, even in serious form. We may assume, therefore, that the degree of anaplasia in carcinoma is not only greater than in adenoma, but that in adenoma the cells function, at least for a time, overactively. This has been convincingly shown by Goetsch [132, 133] in his illuminating studies of the mitochondria in the cells of adenomata of the thyroid.

Is it not conceivable that the tumor, if an adenoma, may in parts have become carcinomatous and thus have given rise to the metastases, while sufficient hyperactive adenomatous tissue remained to cause the toxic symptoms; or that the whole tumor was of an unusual adenocarcinomatous variety capable of producing in pronounced form the picture of Graves' disease?

Tillaux operated upon a third case (No. 48). All of his patients recovered from the operation; although in each instance considerable blood was

lost and in none were the thyroid arteries tied as a preliminary step. In all he practised a rectangular U-shaped incision. The transverse or collar incision, for the popularization of which Kocher deserves credit, had already been employed by Boeckel (1880).[38] Oblique or vertical incisions, often with supplementary cuts, were employed by all the French surgeons up to 1880.

Of the 53 cases tabulated for France, in 15 the patients died (28.5 per cent); but, excluding the relatively minor operations, the fatalities for the 12 total excisions plus the four operations which had to be abandoned and two operations for cancer were 12—a mortality of 66.6 per cent. The cause of death was haemorrhage in seven cases, sepsis in three, haemorrhage and sepsis in one, asphyxia in one, shock in one, unknown in two. No operative procedure was devised in France up to 1883 which definitely advanced the art of operating for goitre. Her surgeons were still far from being able properly to deal with the blood vessels.

ITALY (TABLE II)

In reviewing the contributions of a nation to the solution of an important operative problem one naturally looks for the names of the eminent surgeons, and usually to find that they are well represented, particularly so before the days of high specialization in surgery. Inasmuch as for the excision of a goitre the first and great difficulty was the control of haemorrhage we might hope for greatest assistance from those who had particularly interested themselves in the ligation of arteries, in the surgery of the blood vessels. In the case of Italy we are not disappointed.

Those of us who are familiar with Luigi Porta's great classic on *Delle alterazioni patologiche delle arterie per la legatura e la torsione,* Milano, 1845, may have premised that in considering the various procedures which might be employed to bring about a reduction in the size of a goitre he would first test, as he did, the effect of ligation of the thyroid arteries. After ligating one superior thyroid artery in two cases without effect, he ligated, simultaneously, both of the superior arteries in his third case (Table II, Nos. 2, 3, 4) and noted appreciable, but only temporary, reduction in the size of the goitre. Now he concluded that in the future the inferior thyroid artery should be tied, marvelling that it had occurred to no one to do this. He writes:

"Ligature of the arteries with the object of producing atrophy of tumors of the thyroid gland is a procedure really rational and destined to succeed; but with this object in view one must ligate both the arteries of the same side, the superior and inferior of the side corresponding to the tumor. . . . . which operation (the ligation of the inferior thyroid artery) is, without

doubt, more hazardous and serious than the ligature of the superior thyroid artery, but the dangers are not such as to deter a skillful surgeon; although I have had the operation in mind, I have not attempted it because no patient suitable for the undertaking has been presented to me."

Porta soon had the opportunity to test the feasibility of his proposition.

In July, 1850, a girl, aged 17, entered the clinic. There was a goitre on the left side of the neck, the size of a mandarin, which she had had from childhood, and which had grown rapidly during the two previous years.

The superior thyroid artery could be distinctly seen pulsating at the summit of the circumscribed tumor, but there was no trace of the inferior artery. The right lobe was not altered. It was decided to ligate the superior and inferior thyroid arteries on the affected side.

Operation, July 28, 1850.—Longitudinal incision 4 finger-breadths in length between the sternomastoid and the sternothyroid muscles. As the ligation of the inferior thyroid artery was the most difficult part of the operation, it was decided to ligate this artery first. This was done through the inferior angle of the incision, dissecting with the index finger the cellular tissue towards the back and a little below the base of the tumor. The pulsations of the artery were clearly felt between the trunk of the common carotid and the trachea. Guided by the index finger placed on the thyroid artery, the operator succeeded in passing beneath it a curved Lawrence needle. The eye of the needle being brought out through the incision, an assistant threaded it with a little thread of red silk * which was thrown twice around the artery. Having accomplished this first ligature, the superior thyroid artery was carefully ligated without great difficulty; it ran obliquely from the external carotid to the summit of the tumor.

The operation lasted about three-quarters of an hour, most of the time being spent in ligating the inferior artery. Inasmuch as this, he says, is difficult in any case, and since it was a new operation for which the author had got the idea from studies on the cadaver, he " stayed his hand " and proceeded with great circumspection in cutting the parts and in the search for the vessel. In a footnote the author states that he lost a quarter of an hour in looking for the inferior thyroid artery behind the posterior-inferior part of the tumor, where it would naturally be located. He finally lifted out the lower extremity of the lobe, and found the inferior thyroid beneath it to the left of the trachea, between this and the carotid. He thinks that in another attempt he would achieve his object with greater ease and promptness.

This is probably the first case of ligature of both the superior and inferior thyroid arteries. The operation, in Porta's opinion, proved two things: that the obliteration of the two arteries of the tumor may produce radical effect, and that the two arteries of the other side are not capable of maintaining the proper amount of blood.

* Porta had a fondness for red silk, using it for ligating arteries in his experiments on animals.

Porta performed 11 operations for goitre; the first in 1835; the last in 1850. Five were merely ligations of one or two thyroid arteries; the remainder were small operations—incisions or enucleations of very small tumors. In one instance he ligated the internal carotid artery (No. 5), mistaking it for the inferior thyroid; the error was discovered at autopsy. He was the first to ligate the inferior thyroid artery (No. 13). The most important and the greatest number of operations for Italy were performed by Bottini, who like Porta occupied the chair of surgery in Pavia. Bottini operated upon 18 goitres; Porta, as I have said, upon 11. Thus in Pavia 29 of Italy's 53 operations for goitre were performed; indeed, the surgery of goitre in Italy up to 1883 may be said to have begun and ended and centred in Pavia. Most of Bottini's operations were of considerable magnitude, six of them being more or less complete excisions of the thyroid gland. His first operation, in 1868, was regarded, probably erroneously, as a total removal; his second operation, also believed to be a total one, was not performed until 10 years later; then, in five years, he operated 16 times.

The period from 1878 to 1883 was one of great activity in this field in Germany, Austria and Switzerland—for Billroth, for Kocher and indeed for most surgeons in all surgical fields and in all countries. For Listerism was being introduced—eagerly adopted in German-speaking lands, very tardily in England and the United States. It was not until about 1890, 23 years after Lister's first papers on the use of carbolic acid, and 14 years after his visit to America, that the value of antiseptic surgery was generally recognized in the United States. From 1876 to 1889 the contributions to antiseptic and aseptic technique were made chiefly by the German-speaking nations; since 1889 they have come quite exclusively from America. Bottini observed "strict antiseptic precautions" in 1879 or perhaps 1878 (*vid.* No. 20); for France the first mention in my tables of a Lister dressing is made by Monod, 1880 (No. 38); for Great Britain, by McLeod, in 1880 (No. 40) and by Purcell, in 1880 (No. 41). In the accounts of the operations in America there is nothing to indicate that antiseptic precautions were taken in a single instance. It is remarkable that Bottini, notwithstanding his great experience in operating upon goitres—an experience greater than that of any surgeon of the four countries—should not have hit upon the idea of ligating the thyroid arteries as a measure preliminary to the extirpation of the gland. The preliminary ligation was made only once in our series for Italy—by Berruti (No. 39), who removed the whole gland "by the method of Billroth."

The incisions, except in one instance, were longitudinal, or obliquely so. Ruggi (No. 44) employed a semilunar flap—approximately a collar incision.

Bottini's mortality was 16.6 per cent (3 in 18); for Italy it was 13.2 per cent (7 in 53). The fatalities were distributed as follows: Porta, 1 (No. 5); Bottini, 3 (Nos. 28, 50, 51); Colomiatti, 1 (No. 32); Fiorani, 1 (No. 34); Novaro, 1 (No. 37). There were no deaths from primary haemorrhage—one from secondary. Sepsis was the cause of death in three cases, and in a fourth was undoubtedly responsible for the fatal secondary haemorrhage. One patient died of pneumonia and one from suffocation caused by an unremoved and undiscovered posttracheal lobule of the thyroid.

GREAT BRITAIN AND IRELAND (TABLE III)

Benjamin Gooch. (Nos. 1 and 2.) *Of bronchoceles. Medical and chirurgical observations,* London, 1776, p. 134 (being an appendix to *A practical treatise on wounds and other chirurgical subjects,* 1767).

These first cases for England are essentially the first for the world, if we may exclude cases 1 and 2 of Günther's abstracts. Gooch protested against operation in both cases. Bell [19] and Langenbeck [208] erroneously state that he either operated or intended to operate. Günther believes that he assisted at one of the operations. Gooch's quaint account of these earliest operations (1776) is entertaining and well worth repeating:

"I have had my opinion asked in a great number of tumors of this kind, and cannot recollect an instance of their endangering life, even when enlarged to a very great size.

"It is said, that in some parts of this kingdom, there are persons who undertake to cure this disease; and some years ago I had a letter upon this subject from a surgeon of character at Coventry, written in a very modest and sensible manner, wherein he acquainted me he had sometimes succeeded. But, for my own part, I must ingenuously confess, the various methods I have tried to disperse these swellings, even in a recent state and moderate size, have been defeated; * and I never durst venture to attempt the cure by excision, on account of the vicinity of the large blood vessels.

"I was once indeed prevailed upon to be present at such an operation, where the tumor was of a very large size, and the patient's blood in a thin, depauperated state.

"Before I went the operation was resolved upon, in a numerous consultation, and all I could do was to shew my fears and apprehensions of what would probably attend it, declaring that were it a patient of mine I would not attempt it.

"The surgeon was a good and intrepid operator; but before he had half finished the operation, there was such an effusion of blood, as obliged him to desist and turn his whole attention to restraining the haemorrhage, or,

* "I have talked with many eminent hospital surgeons upon this subject, and they express themselves in the same manner, who have the best opportunities of improving our art, and making useful discoveries."

in the opinion of all present, the patient would have sunk and died under his hands. She died in less than a week and, I was informed, the blood was never totally stopped. The unhappy event naturally brought the reputation of all the surgeons concerned in question.

"I remember another case of this kind, in which my opinion was asked jointly with that of an excellent surgeon in the country, my particular friend,* and the operation was performed against our judgment by one of the ablest surgeons and most dexterous operators in London, which was very near ending in a fatal haemorrhage. The young lady's life was preserved only by having a succession of persons to keep constant pressure upon the bleeding vessels day and night for nearly a week with their fingers upon proper compresses, after the operator had been repeatedly disappointed in the use of the needle and ligature, etc., as his pupil assured me who attended this case.

"I may here add a third similar case, wherein I was consulted, in which the surgeon concerned discovered an earnest desire to attempt extirpation; but I as earnestly urged the arguments I have assigned, which dissuaded him from so dangerous an operation.

"This disease is very frequent in Swisserland, and in the neighborhood of the Alps, which made Juvenal say, 'Quis tumidum guttur miratur in Alpibus.'"†

Sir William Blizard (No. 3, reported by Burns) was the first to ligate a thyroid artery (1811) for the cure of goitre. Death from haemorrhage due to sepsis.

Key and H. Earle. (Nos. 5 and 6.) The ligations of Key and Earle are noteworthy because both patients had symptoms of the disease described 12 years later by Graves. Key's patient died on the second day, probably from hyperthyroidism.

Green (No. 7) is usually credited with the first excision of a goitre in Great Britain. He believed that he had removed the right lobe, but from his vague description of the operation one questions if he knew what he had done. The patient died about two weeks after operation, probably from infection.

Robert Liston. (Nos. 8, 10, 11, 12, 13, 14.) The dexterous Liston was evidently helpless when confronted with a goitre.

Edward Hamilton (1865) (No. 17) was surprised to find how easily both lobes could be freed. He transfixed the "pedicle" (the part adherent to the trachea—the isthmus). There was great loss of blood, but the patient recovered.

Alfred Poland (No. 20) creditably enucleated (1870) an adenoma.

* "Mr. Cooper, late of Bungay in Suffolk."

† "I have been told by gentlemen who have been in Swisserland, that this tumor in the throat, called 'goutière,' is far from being there looked upon as a personal deformity."

TIMOTHY HOLMES. (No. 23.) *A case in which a large bronchocele was removed, with fatal result.* Amer. Jour. Med. Sci., Phila., 1873, n. s. vol. lxv, p. 17.

Timothy Holmes extirpated (1872) with care and skill a great cyst which hung below the patient's waist. His case is erroneously attributed by Süskind to America. Dr. Holmes writes:

"I have read with extreme interest the article on the removal of bronchocele published in the American Journal of the Medical Sciences for January, 1871, by Dr. Greene of Portland, Maine. It happens that I had been led to a conclusion similar to that of Dr. Greene as to the occasional justifiableness of such operations and had had occasion to perform the operation before meeting with his excellent paper. My case, although its issue was fatal, was one which to my mind showed that such operations are not impracticable and that recovery may be reasonably anticipated in a certain proportion of them."

Woman, aet. 65. Enlarged thyroid for more than 40 years. The tumor gradually increasing in size, finally burst and discharged, her friends said, half a pailful. Suppuration of the enormous cyst followed. Greatly reduced in strength and when death seemed inevitable the patient consulted Dr. Holmes, who finally agreed to operate.

The tumor hung below the patient's waist. "On the right side the innominate artery could be felt extending as high as the lower edge of the tumor, and giving off its two branches; the subclavian lying over the pedicle for some distance" (*sic*).

Operation, June 19, 1872.—"I did not adopt the plan of operation proposed by Dr. Greene, of endeavoring to enucleate the tumor without regard to the haemorrhage so produced. In fact, the enormous size of the mass rendered such a plan too dangerous, especially in her enfeebled state. The tumor was surrounded by appropriate incisions around its lower part; flaps were carefully dissected off it, sufficient to cover the vast surface which would be exposed; all large vessels that could be seen were divided between ligatures, and any that spirted were tied at once, and in this way we got down to the base of the tumor. Having dissected the soft parts away from the base of the large cyst to a sufficient extent, I encircled the pedicle with the chain of an écraseur so as to check the haemorrhage, while with an amputating knife I cut away the mass. This left behind a portion of the cyst. After the divided vessels had been secured, the écraseur was removed, and the remains of the cyst partly dissected off, and partly surrounded with ligatures. The operation lasted about an hour; the patient remained quiet under the influence of chloroform the whole time, and did not suffer at all from dyspnoea, except when an attempt was made to pass the chain of the écraseur fairly below the tumor, instead of around its lower end. This attempt completely closed the trachea and stopped the breathing entirely. It was this intimate connection between the deep part of the cyst and the windpipe which obliged us to leave a part of the cyst wall behind; but I carried double ligatures round every accessible part of it—partly to command the haemorrhage, and partly to insure the separation of all the secret-

ing surface. The patient lost very little blood, and her pulse was as good after the operation as before. She passed a comfortable night after the operation, and was able without difficulty to swallow milk and other liquids. Early next morning haemorrhage set in from the upper part of the wound, and before it could be stopped a considerable quantity of blood was lost; in the afternoon erysipelatous redness began to appear over the throat, the pulse became rapidly weaker, unconsciousness supervened, and she died on the following morning, having survived the operation about 39 hours. No postmortem examination was made.

"The tumor, when removed, weighed a little over seven pounds. It consisted almost entirely of the single large cyst, the walls of which were of considerable thickness, containing here and there nodules of calcareous matter, and a few small secondary cysts."

James Syme (No. 25, reported by Watson). James Syme, Scotland's famous surgeon, seems to have been almost as greatly embarrassed (1874) as Liston in the presence of the blood vessels of a goitre.

Patrick Heron Watson. (Nos. 27, 28, 29, 30, 31, 32, 33, 34,) *Excision of the thyroid gland.* Edinburgh Med. Jour., 1874, vol. xix, p. 252.

Watson's triumphs undoubtedly entitle him to the dominant position in the field of goitre surgery, not only for Great Britain, but also for France, Italy and America. Warren Greene excepted, he is the only surgeon of these countries who devised a special method of operating and practised it systematically and with success. His method served him well in the first seven cases, but in the eighth, having wounded "a large vein lying posteriorly in the groove between the trachea and esophagus," and being unable to control the haemorrhage, he accidentally opened the trachea in his haste to detach the tumor from it. The patient died from aspiration of blood. Watson's method almost guaranteed difficulties for the surgeon—difficulties which even those who approved of it would hardly have been able to cope with. He was not master of the art of dealing with blood vessels, and few could have been in those days when surgeons, handicapped by example and training and without suitable equipment, had not developed a deliberate manner of operating. His first operation was in 1871. In 1874 he reported five cases, all successfully operated upon by him. He writes:

"The operation of excision of the thyroid gland has no claim of novelty to render it attractive. It has been practised previously by different surgeons, notably by the late Mr. Liston, and the ill success which attended upon the attempts to extirpate this organ, when most requiring operative interference, has served to deter most writers of the present day from recommending its adoption. Before practising this operation, I had twice assisted at operations where a partial extirpation of the hypertrophied organ was adopted. In one case under the care of the late Mr. Syme, where in a cystic goitre, after tapping and injecting the cyst, aneurismal signs manifested

themselves, he laid open the pulsating sac, and failing to arrest the haemorrhage, which poured out in a rapid stream, he seized first one side of the sponge-like sac and then the other, cutting away as much of the walls as could be exposed. In this case the haemorrhage proved unrestrainable, in spite of stuffing the cavity with sponges and stitching the margins of the incision together over them, and the patient died in our hands. In the second case, Professor Spence extirpated a tumor of the isthmus of the thyroid with complete success, but with great bleeding attending upon the division of the vascular connexion. The haemorrhage which complicated both of these cases was certainly such as to make any one timid in adopting such a proceeding."

Watson describes the second operation in greater detail than the others.

Case 2.—" In her case, I operated by a long linear incision, which sufficed to expose the upper and lower margins of the tumor. After dividing the skin and cellular tissue, and opening the fascia over the interval between the sternohyoid and thyroid muscles, carefully avoiding the fascial sheath of the thyroid gland, I carried my forefinger and thumb over the margin of the tumor at its upper and right-hand corner, and feeling that I had the vascular connexions of the tumor, with the right superior thyroid artery in my grasp, I introduced an aneurism-needle through the fascial sheath in the middle line, bringing it out again at the right side of the level of the equator of the tumor. A ligature was passed through the eye of the needle, and when the needle was withdrawn, the ligature was left in its track. This ligature was confided to an assistant, and held aside. The needle was again passed in the situation of its former emergence, guided by the finger, and then passed beneath the right inferior margin of the gland, so as to include all the right inferior thyroidal connexions. The ligature was similarly withdrawn along the track of the needle. The same process was repeated upon the left side, a ligature being carried beneath the left superior and inferior thyroidal connexions, together with their delicate investing fascia. These four ligatures were then separately tied, so as to secure the vessels included within their cellular sheath as near their origins as was possible; the further separation of the tumor was effected by curved scissors.* As the right superior thyroidal attachments were divided, the ligature came away in the hands of the assistant to whose care it had been confided. A gush of blood took place, but was at once stanched with a sponge thrust into the wound."

In three of Watson's patients (Nos. 28, 29 and 31) exophthalmus was noticed. No mention is made of other eye signs or of tachycardia, or other symptoms of Graves' disease. All of these were " cystic goitres," possibly adenomatous in origin and hence probably toxic. It is noted in one of them (No. 29) that " the anaemia and exophthalmia which were present on admission markedly diminished after the operation." I recall no earlier mention of exophthalmus having been improved by thyroidectomy. It was, indeed, accidentally discovered by several (*i. e.*, Tillaux,[338] Rehn,[288]

* E. S. Cooper of San Francisco practised a similar method in 1861.

Mikulicz [249]) that Graves' disease could be cured by operation upon the thyroid.

In August, 1875, Watson [355] read a paper on *Excision of the thyroid gland* before the surgical section of the British Medical Association in Edinburgh. This paper is almost a verbatim reproduction of his earlier communication in the Edinburgh Medical Journal, 1874. I mention this because Süskind's "two successful operations performed at Chalmer's Hospital," given in his English list of 13, were undoubtedly Watson's, and counted twice; also because Watson in his second paper recounts a fatal case, as follows:

"In this fatal case, the tumor, of a very large size, was adherent to the trachea. After preliminary application of ligatures and the division of the vascular attachments upon the right and left sides had been effected, on turning the tumor to one side, a large vein, lying posteriorly in the groove between the trachea and the esophagus, was unfortunately wounded. The pressure of the sponge applied to arrest its bleeding, together with the drag upon the trachea when the tumor was turned to one side, interrupting the respiration, led me to attempt to separate the attachments of the tumor from the trachea rapidly by means of the knife in a deep wound, from which bleeding was still going on. The thin and soft posterior wall of the trachea thus turned outwards was unfortunately wounded; and, before relief could be afforded by opening the trachea and introducing a tracheotomy tube below the level of the tumor, so much blood had been sucked into the air-passages as to determine a fatal result in the course of the evening."

Spence, McLeod, Whitehead. (Nos. 39, 40, 43.) Three cases operated upon by Watson's method. Spence modified the method by dividing the isthmus and removing the lobes separately. This is probably the first instance in Great Britain in which this procedure was practised. The patient, who quite possibly had Graves' disease, died within 24 hours.

The remainder of the operations tabulated for Great Britain are relatively minor ones, although for the day they were major undertakings in that they represented the best efforts of the best operators.

UNITED STATES AND CANADA (TABLE IV)

We have found reports of 45 operations for goitre in America up to 1883. There were five deaths, one of these (Maury, No. 21) occurring from pneumonia three weeks after operation and when the wound was almost healed and the patient convalescent. Including this case the mortality, therefore, was only 11 per cent; excluding it, 9 per cent. There was only one death from haemorrhage (Cooper, No. 8) unless possibly another in the case of Valentine Mott (No. 2), which Gross reports in a single line. But the haemorrhage in two of Greene's cases was "fearful." In Nathan R. Smith's case sepsis was the cause of death; the huge pendulous tumor was ulcerated

and sloughing at its dependent portion. Of the remaining two fatalities, one (Maury, No. 21) was, as just stated, due to pneumonia incurred three weeks after operation; the other (Hamilton, No. 26) followed a tracheotomy and was also probably due to pneumonia. One would naturally expect to find the greatest mortality in the cases of excision of both lobes; but in the 10 more or less complete thyroidectomies there was not a death. The cases of Nathan R. Smith (No. 4), E. S. Cooper (No. 8), Warren W. Greene (Nos. 13, 18, 19), E. L. Marshall (No. 14), F. F. Maury (Nos. 20 and 21) and G. E. Fenwick (No. 23) deserve especial consideration.

Nathan R. Smith. (No. 4.) *Extirpation of the thyroid gland.* North American Arch. of Med. and Sur. Science, Baltimore, 1835, vol. ii, p. 309.

The patient, aet. about 40, was a Mrs. Wells of Prince George's County, Maryland. The thyroid enlargement was noticed about 1815; this is the only date given in the paper. The tumor "occupied the whole space between the os hyoides above, and the sternum below, and by its weight it had assumed something of a pendulous form, falling over the margin of the sternum. The general configuration of the tumor, in short, was that of a common goitre, and when the integuments were entire it presented the varicose veins usually conspicuous in that disease.

"Some months before the case fell under my observation, the skin covering its most prominent and dependent point had ulcerated, and all the means which had been employed to effect the cicatrization of the sore had failed. There had now issued from this breach of the integuments a dark, fungous excrescence, represented in the drawing, and presenting a strong resemblance to the fungus hematoides. From this excrescence there issued a sanious and offensive discharge, and occasionally slight haemorrhage had occurred.

"On carefully examining the relations of the tumor (together with Professor Geddings, whose advice I requested) we became satisfied that it was one of the thyroid gland, the right lobe of the organ being chiefly concerned. We could distinctly feel and see the sternohyoid and sternothyroid muscles passing like tense ribbands vertically over the tumor. The margins of the sternomastoid muscles, on each side, were raised and spread upon the sides of the tumor. More obscurely, the situations of the omohyoid muscles were also discerned.

"The superior thyroid artery of the right side was distinctly felt and seen, descending superficially, in a tortuous course, obliquely upon the lateral and anterior portion of the tumor. The left thyroid artery could be obscurely felt. On handling the tumor for the purpose of determining its deep attachments, we could readily cause it to glide beneath the muscles of the neck and upon the trachea and larynx; but, owing to its magnitude, it was impossible to determine the nature of all its relations with the deeply seated parts on which it rested. We satisfactorily ascertained, however, that the great vessels of the neck were not involved in, or adherent to, the tumor.

"On carefully weighing all the circumstances of the case, it was manifest that there was no rational ground for hope that any course of palliative treatment would arrest the progress of the disease or effect the cicatrization of

the ulcer. The propriety of attempting the complete extirpation of the tumor was now considered. We arrived at the conclusion that the operation would be attended with extreme difficulty and great peril to the patient, but, as a dernier resort, we regarded it as justifiable in case the individual and her friend, on being made acquainted with the circumstances of the case, should desire the attempt to be made. In a few hours I was informed that our patient had firmly resolved to place herself wholly in our hands, and cheerfully to incur the hazard of any course we might see fit to pursue.

"On the ——— of ——— I performed the operation, with the assistance of Professor Geddings, Dr. Whitridge, Dr. Thomas, of Elk Ridge, and several medical pupils. I commenced the operation by making, in the integuments, an elliptical incision, the length of which correspond with that of the neck. Its central and broadest portion included the ulcerated and fungous portion of the tumor. I then commenced my dissection around the body of the tumor on the right side, it being my desire to expose and secure as quickly as possible the thyroid artery. This I soon effected, though in consequence of its exceedingly tortuous course, I wounded it and secured it at more than one point.

"I now proceeded to raise the border of the sternomastoid muscle, and lay it back from the tumor. In doing this I encountered (that which does not usually exist) the anterior jugular vein, the vessel being somewhat withdrawn from its close proximity to the border of the sternomastoid muscle by the fascia involving it, which was tensely drawn over the anterior part of the tumor. As the muscle was retracted with some force, such tension of the parts was necessarily produced, as compressed the vein and emptied it of its blood. The wounding of the vessel, under these circumstances, was, therefore, scarcely to be avoided. Blood soon flowed freely from the wounded vessel, its flow being hurried by the struggling and deep, strong breathing of the patient. I was perfectly aware of the great danger of the inhalation of air into the vein, and the fatal consequences which might be expected to result from its reaching the heart in any considerable quantity. I, therefore, while making efforts to secure the vessel with the ligature, was careful to grasp the border of the sternomastoid muscle, including the lower portion of the vein, with the finger and thumb. The vessel was secured with the armed needle; but notwithstanding my utmost care, I twice distinctly heard the gurgitation of a small bubble of air, as it entered the vein, at the moment of a strong and deep inspiration of the patient. For a moment I desisted from the use of the knife, and looked into the face of my patient to observe the effects of the ingress of air into the veins. Happily the quantity was not sufficient to produce any obvious effect, and I proceeded with the operation.

"Having now passed through the strata of blood vessels which pertain to the muscles and to the border of the thyroid gland, I proceeded in my dissection with much greater facility. On the left side I effected it with much more ease than on the right; but here also, on the division of the thyroid veins, I distinctly heard the gurgitation of air. To guard against its repetition during the remainder of the operation, I was careful, whenever I divided any fascicules which might be supposed to contain veins, to grasp it firmly with the finger and thumb below the incision, and if blood flowed from the upper portion, to secure the lower with the ligature. I should have

remarked that I found it necessary to divide the tendon of the omohyoid muscle on each side.

"As I progressed with the dissection of the tumor from the deep-seated parts, I found it necessary to proceed with extreme caution. The sheath of the great vessels on each side lay in immediate contact with the tumor and, indeed, was to some extent incorporated with it. I also found that the fascia covering the thyroid and cricoid cartilages was thickened and adherent to the tumor. Its separation from these connections was the most tedious and difficult part of the operation. The separation of the tumor from the parts immediately above the border of the sternum, where I was prepared to expect great difficulty and danger, was effected with infinitely more ease than I had anticipated. The vessels in this region appeared, by the traction of the tumor, to have been elongated, and to some extent obliterated. The thyroid artery, particularly on the right side, presented the appearance of a long, loose, hard cord, pulsated but feebly, and was secured without any difficulty, being drawn out with the tumor. On the left side I secured nothing but branches. The veins of this region were neither numerous nor large, they having no doubt been diminished by the pressure of the parts upon the sternum.

"At length I succeeded in effecting the complete removal of the tumor. There was now left a frightful chasm in the throat, the larynx being dissected quite bare, especially on the right side, and the trachea exposed as low as the border of the sternum. The great vessels on each side were also seen throbbing in their sheaths. The recurrent laryngeal nerve was distinctly seen on the right. The last point from which I detached the tumor was a portion of the thickened tissue covering the thyroid cartilage, and its attachment here was very firm. When I had severed it, two or three minute arteries sprung, one of which I immediately secured; but as the haemorrhage then appeared to cease, I did not take up the others.

"The operation was necessarily painful and protracted; its execution occupying an hour; the patient, however, endured her sufferings with wonderful fortitude, and at no time did there take place any alarming sinking of the powers of life. Twice or thrice, at her desire, I had delayed a few minutes to allow her a moment of comparative repose, but neither then, nor after the operation, did there appear to have been inflicted any serious shock.

"In the morning, on visiting Mrs. Wells, I was alarmed at finding the dressings bathed in blood which was still flowing from the wound, and evidently of the arterial hue. I immediately cut the stitches, opened the wound, and turned out a mass of coagulated blood, and found the bleeding to have occurred from a minute artery seated where the last attachment of the tumor had been cut away. I secured the vessel with the ligature, and as there was a disposition to haemorrhage from minute vessels, I applied to the part a small compress of lint dusted with alum powder.

"On the fifth day, however, there occurred a severe rigor, followed by fever, sonorous and embarrassed breathing, cough and irritability of the stomach. It passed off with a sweating stage, precisely as a paroxysm of intermittent fever. The wound, which had suppurated kindly, now began to exhibit a flabby appearance, and to discharge an unhealthy secretion.

"It is not necessary that I should relate the subsequent progress of the case; suffice it to say, that the rigors recurred every day, notwithstanding our endeavors to parry them, and that the patient expired on the 13th day. The chills were evidently of malarious origin, and my patient undoubtedly came to me predisposed to intermittent fever. To this, in part, I think I may with propriety ascribe the fatal result."

When we consider that the patients were unanaesthetized and that the surgeon until many years after Nathan R. Smith's day was without artery forceps, and had to rely chiefly on aneurism-needles, hooks and the pressure of fingers or sponges for the control of haemorrhage we must concede that the most difficult task of the present-day surgeon is hardly more creditable than this operation by Smith upon the thyroid gland in 1835. The control of haemorrhage has always been, as it is today, the chief concern of the operator. Now the surgeon is provided with literally hundreds of artery clamps and the patient being anaesthetized there is no need for haste; the operator, unperturbed by the cries or struggles of the patient or the fear of haemorrhage, proceeds calmly and surely from one step of a well-perfected method to the next.

Nathan R. Smith had quite surely never seen an operation performed upon the thyroid gland, and it is not unlikely that he had never heard of such an operation, although he concludes his paper with the sentence, "Instances in which the operation has been successfully accomplished are no doubt fresh in the minds of the readers."

My admiration for Dr. Smith, Baltimore's "Emperor," has been greatly increased since reading his modest and lucid report of a case, the importance of which he could hardly have comprehended. I have seen no reference to this case in the literature except in the Index Catalogue of the Surgeon General's Library. It is surprising that Samuel D. Gross makes no mention of this chef d'oeuvre of Nathan R. Smith.*

E. S. Cooper. (No. 8.) *Operation for the removal of bronchocele. Death of the patient.* Cinc. Lancet and Obs., 1860, vol. iii, p. 15.

"Important surgical operations proving successful, should generally be reported to the medical world, but those terminating fatally should always have the widest range of publicity among the profession.

"In consequence of the great fatality attendant upon operations for the removal of bronchocele, the practice is now generally abandoned. The extent and importance of the tissues involved, when the tumor is large, rendering the operation dangerous in the highest degree, is sufficient reason why it should not generally be resorted to, except in extreme cases.

"There are those, however, where the disease is rapidly growing, and from the hardness of the enlargement and its pressure upon the windpipe

* Both were professors at Jefferson Medical College—Smith, professor of anatomy from 1825 to 1827; Gross, professor of surgery 29 years later.

suffocation must inevitably result at no distant day, in which an attempt at removal may be made. Such is the one I am about to relate.

"Case: Mrs. M., aet. 24 years, consulted me on the 3d of October, 1859, in consequence of an enlargement on the left side of the neck, extending from the clavicle to near the chin. It was twice the size of a man's fist, and had been over four years attaining that size, and during the preceding year increased very rapidly. It pressed heavily upon the trachea, which was considerably flattened. Pulsation of the left carotid artery could be distinctly heard on applying the ear over it, while the sounds of expiration and inspiration could be as clearly heard over it as by applying the ear to the chest. There was distinct pulsation nearly all over the tumor. In the act of swallowing, it arose and fell with the motion of the trachea, and was much more firmly fixed over the region of the trachea than over the outer part of the neck.

"I was convinced that I had made a true diagnosis before operating, and that it was not aneurism, but bronchocele, though some of my medical friends thought it might be the former.

"I have been consulted in regard to many cases of bronchocele, but I never saw any one presenting so fearful a prospect for the use of the knife, and from the lights before me, conferred by the experience of others, I never would have decided upon removing this disease by the knife; and notwithstanding the certain prospect of a fatal termination of the case at an early day, I would have either sent the patient away hopeless, or pursued a temporizing course, as had been my custom in other cases, but for having decided to try the écraseur, by which I concluded I might succeed in removing it without the dangers of fatal haemorrhage, so often attendant upon the use of the knife.

"For the purpose of applying the instrument, I made the crucial incision over the tumor, and reflected the flaps of integument down its sides until I thought one-half of it was exposed, after which I passed needles armed with ligatures deeply into its substance in six different places, to be strongly drawn upon by my assistants, thinking thereby to force the chain round the tumor to its under side. It was soon ascertained, however, that the chain would slip forwards in spite of the ligatures. I, therefore, made a further dissection, so as to expose the entire anterior half for the purpose of inserting the ligatures as before.

"About this time the procedure was arrested by a collapse of the patient, apparently from the effects of the chloroform.

"The patient became pulseless, and for some seconds respiration appeared entirely suspended, but by the use of brandy and other stimulants, with electricity, she had reaction, when the écraseur was again applied; but the use of the instrument was still found to be impracticable, in consequence of the firm attachments of the tumor to the trachea, in consequence of which the chain would have broken down and carried part of it away, instead of separating it from the tumor. I, therefore, laid aside the écraseur, and took up the scalpel to dissect the tumor away from the trachea; but in effecting this I found it necessary to ligate the primitive carotid artery a little above where that vessel crosses the lower part of the trachea.

"This I think was the most difficult dissection I ever did. The extreme low point on the neck at which I was compelled to ligate this vessel in order to place it out of the reach of being subsequently wounded, together with the density of the abnormal adhesions among the different structures, rendering their separation with the scalpel exceedingly difficult, while the use of that instrument was hazardous in the extreme, were the causes of this dissection being so difficult.

"The carotid artery being tied, I concluded to extirpate the tumor by the knife, which was accomplished in one hour and 20 minutes from the time the operation was commenced, with the loss of a comparatively small amount of blood.

"The internal jugular vein was not wounded, but the anterior and external jugulars were both ligated above and below, as also the superior and inferior thyroid and some other enlarged veins. There were but four arteries besides the carotid and inferior thyroid ligated.

"The tumor being removed, the flaps of integument were brought together by sutures, and were formed sufficiently large to cover the exposed surface. Adhesive straps were put upon the wound, and a piece of lint wetted with an evaporating lotion placed over it, when the dressing was completed.

"The patient revived considerably, and appeared to be doing tolerably well for two hours, but perfect reaction did not take place, and she died in five hours from the time the operation was concluded.

"The great length of time occupied in this operation was owing to the care with which part of the dissections had to be made, the delay occasioned by the sinking of the patient at one time from the chloroform, and the time occupied in the efforts to use the écraseur."

E. S. Cooper. (No. 9.) *Cutting away of a bronchocele without haemorrhage, with a case. Remarks.* Med. and Sur. Reporter, Philadelphia, 1862, vol. viii, p. 38.

"*Operation, March 27, 1861.*—Mrs. P., aet. 27, applied to me with a small, tumor, situated at the isthmus of the thyroid body, of 10 months' standing. It was the size of a hen's egg, and moved up and down in the act of swallowing. It was unattended with pain and had increased in size but slowly. Its growth was, however, constantly perceptible to the patient, and caused her great mental anxiety.

"Being convinced that all methods in use among surgeons will fail to give that freedom from haemorrhage, at the same time certainty of success, with avoidance of suffering to patients, and of deformity after cicatrization, which the nature of the disease and surrounding tissues reasonably warrant, I have for some time been gradually departing from the usual practice.

"My first method was dissecting away the tissues covering the tumor, then passing ligatures through its lower as well as its upper parts so as to include the thyroid arteries.* After this, transfixing the enlargement at different points and in different directions by needles armed with ligatures of great strength, in case of large tumors using a sort of nevus needle made,

* Thus he anticipated Patrick Watson, who, 13 years later, described the very similar method which he and his followers practised with marked success.

on purpose, with a long, piercing extremity, sufficiently long to transfix readily a tumor four inches in diameter.

"Many double ligatures being thus passed through the tumor and their ends tied tightly together, it is at once reduced to one-fourth or one-sixth of its natural size. Sloughing occurs in these cases without secondary haemorrhage. But as cases operated upon in this way have been often published with their results, I shall not dwell upon it now, but proceed to my *second* method.

"This consists in exposing the tumor as before and transfixing it above and below, throwing ligatures around the substance as described before and cutting it away close to the ligatures. This was done in the case mentioned without more haemorrhage than results from the simplest operations. Should the wound bleed too much in any case, I would whip-stitch the entire cut surface.

"In this case every symptom was favorable from the commencement, and on the 21st day after the operation the patient left for her home in the country, almost recovered, and with very little deformity from cicatrization, which was almost complete.

"Remarks: Although the method of treatment adopted in the above case is applicable to those of bronchocele generally, still the surgeon will now and then meet with the vascular or *aneurismatic* bronchocele in which the excessive haemorrhage resulting from every stroke of the scalpel will be such that he is finally compelled to abandon the operation; but these cases are extremely rare, and the surgeon should not in any case be too much alarmed at a sudden gush of blood, as that will often occur in cases where the haemorrhage is perfectly controllable by occasionally whip-stitching the bleeding surface.

"I repeat here, substantially, remarks made in the publication of other similar cases elsewhere, which is done so that any who read this report, but may not have read the others, will understand it.

"Surgical writers often state that the method of ligating the thyroid arteries frequently results in secondary haemorrhage. This I have never seen in any case. Is it because of ligating the arteries in the midst of a mass of other tissue and at the same time strangulating every part of the tumor, as mentioned in the first method, or removing the unnatural growth close to the ligature, as in the second, thus causing a consolidation of the tissues around the arteries, that prevents the secondary haemorrhage as chronicled in the books?

"And at this point I am reminded of a question which has often arisen in my mind, as to whether the ordinary method of ligating blood vessels by isolating them completely first, is not based upon erroneous principles. Whether the necessity of drawing the ligature sufficiently tight to cut the inner coats of the artery, is not favorable to the production of secondary haemorrhage, by inducing the too early sloughing of the ligature; and whether it would not be better in all cases to include such surrounding tissue as would admit of it, is also a question.

"Of course a nerve could not be included in the ligature; but muscle, fascia, cellular tissue, and even the veins might be included. The veins which have heretofore been supposed to be particularly disposed to phlebitis

when wounded are found to be not more so than the arteries, unless the wound of the vein causes the arrest of the undecarbonized blood in its way back to the heart. But when that occurs, it becomes dangerous, because the accumulation of venous blood acts as a foreign substance and source of great irritation.

"I am now constantly in the habit of sewing up the ends of arteries, even of considerable size, in a mass of other tissue, when the vessel is either hard to isolate and tie, or in that exposed situation which would leave the ligature liable to be disturbed by the sponge or other cause during the subsequent steps of the operation.

"I do not believe that it is at all necessary to draw a ligature sufficiently tight, when applied to any artery, to cut the inner coat, as is supposed. Pressure, by which the haemorrhage will be arrested, would produce a change of action in the parts sufficient for the effusion of fibrin, by which the vessel would become filled.

"We have innumerable examples of pressure causing the effusion of coagulable lymph. Why should a ligature be drawn more tightly upon an artery than simply to arrest the haemorrhage? It appears to me that if there is any reason why this should be done, it is to keep the ligature from slipping, which may be readily effected by including some of the surrounding tissues. In natural amputations of the extremities, the arteries are hermetically sealed by the process of nature, and a firm clot is formed in the vessels without the aid of ligature. Who knows whether the inner coats of the arteries are cut by the ligatures even when drawn tightly? If not, it is very obvious that a very tight ligature would favor the too early division of the vessels without there being any just cause for the risk."

William Warren Greene. (No. 13.) *Successful removal of a large bronchocele.* Med. Record, New York, 1866-67, vol. i, p. 441.

"It is well understood by the members of the profession that extirpation of an enlarged thyroid gland is one of the most fearful operations ever undertaken by the surgeon. While there is always great danger from shock, secondary haemorrhage, inflammation of the cervical vessels and of the esophagus and respiratory organs, *the* danger which overshadows all others, hanging like a thunderbolt over patient and operator, is terrible and uncontrollable haemorrhage.

". . . . such surgeons as the Coopers, the Bells, Ferguson, Velpeau and others have been obliged to abandon operation.

"I have quite carefully examined the literature of this subject, and so far as I can learn, *all* bronchoceles that were ever successfully removed (and there are very few) were small. I am very confident that none were as large as that which I shall describe." *

Woman, aet. 45. The tumor had been growing for 26 years. Pressure symptoms were so great that attempts to swallow or talk caused "terrible spasms of dyspnoea." She was unable to lie down. Suffered from headaches and giddiness and could not stoop without losing consciousness.

* Greene evidently knew nothing of the European literature.

Operation (dates not given) (August (?), 1866 (?)).—Vertical incision. "Fearful haemorrhage" from veins on exposing the tumor. "I now rapidly separated the areolar attachments, and in a few seconds was at the pedicle, which I found containing three large arteries whose pulsations were very distinct, and which were my guides for dividing the pedicle into three parts, which I also accomplished with the fingers. I immediately tied each third with a ligature composed of 18 strands of saddler's silk, *saturated* with wax and *loosely twisted*. As I drew the last cord all haemorrhage instantly ceased. The pedicle was carefully divided close to the goitre, and it removed. During the dissection I found at one point the tumor quite firmly adherent to the sheath of the vessels; and while separating it, a gush of venous blood indicated the rupture of a large vessel. The finger of an assistant controlled it until the ablation of the bronchocele, when examination proved the internal jugular to be wounded. This was tied with a ligature of three strands of silk loosely twisted; no other vessels needed interference. The entire operation occupied 22 minutes."

The patient was restored to perfect health. The weight of the tumor was one pound and nine ounces. The paper is illustrated with interesting woodcuts showing the patient before and after the operation.

William Warren Greene. (Nos. 18 and 19.) *Three cases of bronchocele successfully removed.* Amer. Jour. Med. Sci., Philadelphia, 1871, n. s., vol. lxi, p. 80.

No. 18: Woman, aet. 40. Tumor, the size of a small orange, in the right lobe caused great difficulty in swallowing.

Operation, October 25, 1869.—The tumor was removed by enucleation. Simple operation except for adhesions to esophagus. Recovery.

No. 19: Woman, aet. 35. The tumor had been growing slowly for 20 years. Headache, vertigo, dysphagia and an alarming degree of dyspnoea were complained of when she consulted Dr. Greene in August, 1869. "To the fingers, as to the eye, the tumor pulsated everywhere." At one point there was a distinct thrill and bruit. "So marked and peculiar was it that an eminent hospital surgeon of Buffalo had pronounced it an aneurism of the common carotid.* But it was certain that this case was more formidable than either of the others—involving both lobes, being of immense size, and more vascular than any goitre I had ever seen; and I did not believe that removal by the ordinary mode of enucleation of morbid growths, attempting to control haemorrhage step by step, was possible. I considered the chance to be a hundred to one that she would die upon the table or of secondary haemorrhage soon after."

Operation, January 20, 1870.—Ether. Vertical incision. "At very many points the thin coats of superficial vessels gave way, and uncontrollable oozing resulted. Still the haemorrhage was not immediately alarming until the dissection, which was carried on by the fingers, reached the calcareous portion of the tumor on the right side. Here adhesions were encountered

* Thanks to the courtesy of Dr. Frederic Henry Gerrish of Portland, Me., who assisted at the operations in this and the previous case, I have photographs of this patient. There is nothing in the facial expression definitely to indicate Graves' disease.

of considerable firmness, and as they yielded to the most careful efforts I could make, the large branches, which had given the aneurismal thrill, and whose coats were extremely attenuated, burst, and immediately we had the most fearful haemorrhage, such as one who has not seen it can hardly realize. This took no one by surprise, as I had already forewarned my assistants of its probable occurrence, and in such event of the entire futility of any expedient, except the rapid completion of enucleation and seizure of the vessels at the base of either lobe. This I accomplished in a very few seconds and was enabled so to seize the pedicle with the fingers as to suppress the bleeding measurably until I could transfix it with the blunt needle, armed with double ligature made of eight strands of saddler's silk. This was carried in the median line from below upward, close upon the trachea, and either ligature tightened sufficiently by a single knot to control the haemorrhage and give time for examination. I had hoped to separate either half of the pedicle into as many parts as there were arteries, as I did in my first case. This I found impossible from the firmness of the tissue, unless I used a cutting instrument, which I did not dare to do. I, therefore, tied either half as tightly as possible, and carefully severed the tumor from its attachments. This being done, seven small arterial twigs, not connected with the growth, were tied, when all haemorrhage ceased. The wound was now kept open, only ether enough being administered to keep her quiet, and time given for glazing of the surface and reaction of the circulation. Within 10 minutes the vessels in every part of the exposed surface were throbbing violently, and in 15 minutes from the ablation of the tumor the inferior thyroid artery of the left side escaped from the ligature and spirted with great violence. In my own opinion, as in that of the attending surgeons, this vessel was equal in size to the common carotid in its normal condition. In a moment this was seized and secured; then, the entire left half of the pedicle being transfixed with a tenaculum, a new ligature of 12 strands was carried underneath both the original one surrounding the pedicle and the separate one around the inferior thyroid artery, and drawn as tightly as possible. From this time, all bleeding was arrested, and in a few minutes the wound was closed with silver sutures, a light dry compress applied, and the patient placed in bed with a fair pulse of 100 per minute, and presenting no marked signs of collapse."

Secondary haemorrhage occurred on the tenth day. "One week before the operation she lost her voice entirely. Since the removal of the tumor she has fully recovered it."

It is interesting to note that the laryngeal nerves have rarely been paralyzed in the many cases operated upon more or less in this fashion, and that neither cachexia strumipriva nor tetany developed. Presumably a considerable amount of thyroid tissue was left behind in the écraseur ligatures *en masse*.

The thyroidectomies of Warren Greene deserve conspicuous mention in the history of American surgery; for this reason I have quoted at such length from the picturesque and spirited describings of this dauntless practitioner.

E. L. Marshall. (No. 14.) *Extirpation of the entire thyroid gland. Recovery.* Chicago Med. Jour., 1867, vol. xxiv, p. 97.

"In your journal for December last, I find the report of a case of removal of one-half of the thyroid gland, by Prof. Wm. Warren Greene, being the third instance (so far as my own information extends) of this operation having been successfully performed in America. Dr. Geo. McClellan, Sr., of Philadelphia, is said to have succeeded in a single instance (his being a single lobe only) and my own, performed January 18, 1852, comprising the entire gland, with Dr. Greene's more recent case, of August 19, 1866; all of which patients have had good recoveries. I am unaware, at this time, of there being a single case of a fatal or unsuccessful operation in this country.

"My patient, Mr. John Mank, now residing at Bridger's Corners, Mercer Co., Ill., had consulted a number of eminent surgeons, among whom were Professors Mussey and Joseph N. McDowell, also Professor Brainard, and S. S. Cooper, of Peoria, all of whom, after an examination of the case, gave it as their opinion that an operation for removal of the gland might, eventually, become justifiable. To my own knowledge, Mr. Mank has been, from time to time, through a period of many years, subjected to vigorous treatment, with reference to absorption of the tumor, all of which had not even checked the progress of the morbid growth.

"Referring to my notes, I find that on the 12th of January, 1852, the patient had for three months been unable to lie down, and required constant watching to save him from suffocation; was subject to spasms of great dyspnoea; constant headache; had twice had convulsions from attempts to lie down; was mentally despondent, declaring that he preferred death to such an existence. After making a full statement of the hazards incidental to extirpation, it being the only resource left upon which to fall back or recommend, I left it with himself for decision. He promptly requested me to undertake the removal of the tumor. In this decision I had the happiness of having the concurrence of Drs. Adam Clandaning and A. B. Campbell, whose valuable counsel and assistance I here take the occasion to acknowledge.

"The patient, Mr. Mank, aged 40, a gentleman of high order of intelligence, and, previous to his health having been impaired by his present affliction, a man of great muscular power, possessing a high order of moral courage—such courage, indeed, as I have seldom, if ever, witnessed in any other person.

"The patient, declining the use of an anaesthetic, took his position (agreeable to his own request, in an arm-chair) and I proceeded to operate by making an incision through the median line, commencing a few lines above, and completing as much below, the lower border of the tumor. This wound I transformed into a crucial incision; detached the flaps and dissected them down to their base; fleshy fibres that were not easily pushed aside were divided transversely, until the entire superficial surface of the body was exposed. I now separated the tumor from its bed, by dividing the several fasciae on the director and tearing up the areolar tissue with the finger and handle of the scalpel, until the base of the gland was freely exposed. There was but little haemorrhage from the superficial vessels of the tumor, and

none that required especial care, save a couple of small arteries that were found lying alongside the thyrohyoid muscle, imbedded in the cellular lamella. These were ligated—they were, perhaps, branches of the lingual or maxillary arteries. The pedicle of the tumor being reached, I found each lobe to be supplied with two arteries (the superior and inferior thyroid). Each portion containing a vessel was surrounded by a heavy ligature of loosely twisted saddler's silk. The inferior arteries were now sealed without any disturbance of organic function; but on attempting to tighten the ligatures of the superior vessels, we were met by a difficulty that was well-nigh fatal to our operation. This occurred incidental, as I believe, to pressure upon a branch of the great sympathetic, the pneumogastric, the glosso-pharyngeal, or fibres from two, or possibly all three, of those important nerves. Be that as it may, on any attempt to ligate these vessels, the patient suffered from severe paroxysmal cough, labored breathing, and a lessening of the force of the heart's action that was truly alarming. As we could not hope to be able, under the circumstances, to find and exclude the small, thread-like fibre from the ligature, we did that which I believed to be the next best thing in the premises—to destroy the functional integrity of the nerve; this was done by tightening the cord and holding it firmly so long as the patient was able to endure and live, when it was loosened and interrupted organic functions were allowed to resume something of their normal condition. This required but a few minutes, and here was witnessed a heroism upon the part of Mr. Mank that was truly sublime. Nothing daunted by the peril, so well understood by himself, he was always ready, after his brief rests, to request that the work of nerve-crushing might be resumed.

"After several efforts of this kind, I had the happiness of knowing that the difficulty was so far overcome as to admit of ligation, which was accordingly done, and the tumor was removed without farther trouble.

"The tumor, when examined, was found to be hard, firm, with cartilaginous deposits, and weighed one pound 11 ounces, avoirdupois.

"I would especialy invite attention to the fact that, in the case of Mr. Mank, the only serious difficulty encountered during the operation was in the dissection of the nervous communication between the gland and nervous centres, while in Dr. Greene's case no such trouble was had, neither have I any knowledge of any such barriers to the successful execution of the operation being encountered by any other party attempting the extirpation of this gland; while all refer to the fearful haemorrhage incidental to the rupture of delicate superficial veins, spread like a network over the body. In my own case, the walls of those vessels were sufficiently firm to admit of careful dissection, without risk to their continuity."

F. F. Maury. (Nos. 20 and 21.) *Extirpation of the thyroid gland for cystic enlargement.* Photographic Review of Med. and Sur., Philadelphia, 1871-72, vol. ii, p. 17.

"During January of the present year, my colleague, Dr. Parry, of the obstetrical staff of the Philadelphia Hospital, asked my advice in reference to a tumor of the neck, in a patient then an inmate of his wards. After repeated and careful examinations, it was clearly defined to be an enlarged thyroid gland.

"The history was as follows: The woman was 23 years of age, born in Cheshire, England, and when nine years old first discovered a small swelling on the anterior part of the neck, its situation being somewhat to the right of the median line. This slowly but gradually increased up to the date of my seeing her. She then complained of but little pain, some difficulty in deglutition, and scarcely any obstruction to her respiration, save in certain positions. She manifested great desire to be rid of the tumor, though the strongest representations of the gravity of the operation were fully made and understood. It was decided to attempt the reduction of the tumor by the process of electrolysis. This was fully tested and afterwards abandoned, the result being entirely negative. In February, before extirpation was resorted to, a final effort was made to produce an impression on the morbid mass by electrical cauterization, which was effected by means of a large Bunsen's battery of 15 cells. This procedure was more effective than the former. The phenomena here evolved were of a very interesting character. A perceptible crackling noise was audible in the tumor during the application of the needles, which were heated almost to a white heat. Great induration was developed around the negative pole, and the tumor at once began to increase in size, measuring before the operation 16 inches, and in two hours 17. Great dysphagia also followed, and excessive pain when the parts were touched or the head moved. During the day following, all the symptoms of acute inflammation were present; these, however, began to subside in a few days, leaving the patient in her former condition, save the induration around the site of the entrance of the negative pole. In April it was finally decided to resort to the knife. The patient being fully influenced by chloroform, an incision 5 inches in length was made over the most prominent part of the growth, parallel with its perpendicular diameter, and this joined by a horizontal one of sufficient extent to allow free manipulation during the operation. The firm, dense capsule of the gland was soon reached by a division of the bands of fascia overlying. It was soon seen that the thyroid arteries were greatly enlarged, more especially the right and left inferior. All these were well secured in turn, as likewise all smaller vessels. In this way *absolutely* all haemorrhage was avoided.

"The cyst was then peeled away from the trachea for the extent of 3½ inches. The sheath of the right carotid was undisturbed, but fully exposed, as also that of the left. The wound was closed, no haemorrhage followed, and the patient did well, excepting a slight attack of erysipelas, which came on three days after, and, queerly enough, involved the face and portions of the neck to the entire exclusion of the wound.

"This case is pregnant with interest, but space will not admit of its free elaboration. It must suffice to say that here the repeated use of electricity would not have availed much, as the consistency of the tumor would have resisted it entirely, or the time occupied by this mode of treatment would have compassed many months. When the capsule was opened, the structure was found to be dense, and very tenacious in character, and not apparently very vascular. The belief that this operation in many cases can be effected is confirmed by the fact that I removed, some weeks after, another very large growth of the same kind in the same manner, and with the best result, as respect haemorrhage and shock. This patient did well for 21 days, and was

then seized with pneumonia and perished, after all the ligatures had become detached and the wound almost healed. The subject of this photograph was seen some days since in the enjoyment of perfect health. She has never experienced any difficulty, save slight aphonia, which has now disappeared."

H. G. Jameson (No. 3) was the first and only American on our list and the tenth in the world to tie a thyroid artery for the cure of goitre. The ligation was made in 1821, only 10 years after the operation of Sir William Blizard, who was, as I have said, the first to perform this operation. Four of Great Britain's surgeons besides Blizard attempted to cure goitre by ligation of one superior thyroid artery (Coates, 1819; Key, 1824; Earle, 1826; and Sir Benjamin Brodie, 1832). In Earle's case the opposite superior thyroid artery was tied at a second operation, a month after the first. Alquié (1854) was the only French surgeon to ligate the thyroid arteries *per se*. In Italy the first five operations for goitre were nearly arterial ligations—Marzuttini, 1844, and Luigi Porta, 1835, 1846 and 1848 (2). At the autopsy of Luigi Porta's second case it was ascertained that his ligature had been placed on the internal carotid which he had mistaken for an enlarged inferior thyroid artery. In 1850 Porta ligated the inferior and superior thyroid arteries of the left side. The circumscribed goitre of the left lobe vanished, leaving no trace. No further attempts were made by Italian surgeons to cure goitre by ligation of the thyroid arteries. W. H. Welch in 1874 * (unpublished prize thesis) collected 32 cases of ligation of one or more thyroid arteries for the cure of goitre.

Ch. G. Lange [207] is accredited with having been the first (1707) to suggest tying the thyroid arteries in case of goitre. This is what he has written:

"Magis vero efficax esset sectio Arteriae, quae ad strumosos tumores sanguinem defert, modo vas illud prompte inveniri, & haemorrhagia statim iterum sisti posset. Veterinarii quidem hoc modo procedere dicuntur, & arteriam, quae ad strumosos tumores equorum defertur, abscindendo, efficere, ut strumae evanescant; in homine tamen haec operatio non sine periculo instituitur." †

To base a claim of priority for Lange on the evidence furnished by the above quotation would seem to require a highly developed patriotism or a carefully nurtured naïveté. Lange, apparently, did not distinguish scrofulous tumors from goitre, or if he did he had in mind the former, not the

* St. John's paper [813] was founded upon this thesis of Dr. Welch.

† "But more efficacious would be the division or ligation of the artery which conveys blood to the strumous tumors, provided this vessel may be easily found and the haemorrhage forthwith checked. Veterinarians, indeed, are said to proceed in this manner and by dividing the artery which supplies the strumous tumors of horses to bring about the disappearance of the struma; in man, however, this operation will not be undertaken without peril."

latter, when he proposed ligating or dividing "*the* artery." Furthermore, he had the impression that one artery supplied "*the strumous tumors*," and unquestionably had not the remotest notion of the whereabouts of this hypothetical vessel. And, finally, he warns against undertaking on man this operation, the credit for the devising of which he accords to the veterinarians.

Apropos of patriotism, I yield to the temptation to offer my readers extracts from an amusing controversy between von Walther and Chelius on the subject of national as well as individual priority. Philipp von Walther was the first to tie successfully the superior thyroid artery, the case of Blizard having terminated disastrously (*vid.* Table III, Case No. 1).

Chelius[81] writes: "Because I credit the Englishman Blizard with the first performance of this operation (and I know of no other German author who has done so) Herr von Walther has been stirred to direct against me the following rather strong attack. It will surely be a satisfaction to my highly esteemed Herr von Walther to have the matter cleared up, inasmuch as the correct history of the operation in question is at stake.

"Herr von Walther says: 'Moreover will our dear countrymen ever cease abasing German achievements in surgery to the indisputable minimum, and creating prejudice with scholarly industry against the German discoverer whenever they can exhume from a foreign land the slightest trace of priority? Certain it is that among the English and French we have no competitors for the glory of such uprightness, probably also none to envy us. Even were it true that the ligation of the superior thyroid arteries for the cure of aneurismatic goitre is a discovery of English surgery, as a German writer relates, it still remains a fact that independent of this and simultaneously (?!) or with a trifling difference in time, the idea originated in Germany and was there successfully carried out. Untrue it is (!) that the operation was proposed by Jones. Jones speaks of the ligation of the thyroid arteries only interrogatively, as of a means to make possible the extirpation of the thyroid gland, not to cure the goitre without extirpation (?!). In regard to the time when Blizard performed his operation, there is nothing to indicate it either in the brief account by Burns nor in the equally brief notice in S. Cooper's *Surgical Dictionary,* 4th Edition. Nowhere is the date of the operation mentioned. From what source then does one know what so positively is asseverated, that Blizard undertook this operation before me? The meagre descriptions of Burns and Cooper seem indeed to prove that they and Blizard had no knowledge of my paper on goitre. But I know with certainty that this little paper was carried to England soon after its appearance. In that country, too, the *Salzburger medicinisch-chirurgische Zeitung* is read, in which some years earlier I had published a brief report. Since, however, I do not know the date of this operation I will not quarrel about it. It would be just so much the more interesting and gratifying if indeed the idea of this undertaking had originated with him or Burns. Such a coincidence would be the more likely to kindle a favorable fore-judgment and entitle to the hope of its future establishment in the field of operative surgery.'

"The entire passage, so far as it concerns the history of the ligation of the thyroid arteries, contains nothing but untruth.

"In the second volume of my *Handbuch der Chirurgie,* p. 1160, where I ascribe the priority of the ligation of the thyroid artery to the Englishman Blizard, I have quoted from S. Cooper's *Surgical Dictionary,* London, 1813, 2d Edition, and added the German translation from Burns' *Surgical anatomy of the head and neck.* Had Herr v. Walther seen this second edition of S. Cooper in which on the dedication leaf the 4th of February, 1813 is noted, he would have been able to acquire the absolute conviction that Blizard several years earlier than he must have performed this operation. But if this interval of time should not be great enough for the pronouncement of an opinion in regard to the priority of this operation, then the original paper of Burns (Edin., 1811, p. 202) suffices to dispel any doubt of the most sceptical. These are the sources upon which I base my assertion. Inasmuch as I give reference to the second edition (1813) of Cooper, Herr von Walther should not have taken refuge in the fourth edition which appeared a long time thereafter. Concerning the date of the Blizard operation one need not harass himself so very much, since it is not a question of days or months, but of several years. . . . .

"How does v. Walther happen to make such a statement as this: 'It is untrue that the operation was proposed by Jones. Jones spoke of the ligation of the thyroid arteries only interrogatively, as of a means to make possible the extirpation of the thyroid gland.' Jones says: 'I inquire then further, cannot this procedure, stemming the circulation of the blood through the arteries, be employed with advantage in cases of bronchocele?' Neither in this nor in the appended comment of Spangenburg is to be found the remotest justification for the view that this ligation was proposed as a means for making possible the extirpation of the thyroid gland; an inference quite to the contrary is to be drawn. The entire asseveration of v. Walther I can explain to myself only in this wise, that with Jones he confounded Charles Bell, who in his *System of operative surgery* says: 'Before making the attempt to excise the thyroid gland one might propose ligating the four arteries which supply it.' This passage has no bearing upon the question of ligation of the superior thyroid arteries of which we are speaking; wherefore I did not refer to C. Bell in narrating the history of this operation. On whose side now is the untruth? After all, as a result of thorough investigation it develops that the honor for the suggestion to ligate the thyroid arteries in cases of goitre belongs to a German, to Ch. G. Lange, who already in the year 1707 speaks of it most unequivocally (*sic*). Whether this will be satisfactory or not to Englishmen is immaterial—history must not be distorted (Die Geschichte muss gerecht seyn)."

We have seen, just above, how precise were Lange's views on the subject, and it is fortunate that the Library of the Surgeon General possesses his precious tract.

GERMANY

To tabulate the numerous operations for goitre performed by German, Austrian and Swiss surgeons (395 up to 1883) in the same elaborate man-

ner as has been done for the British, French and Americans would require too much space; I have, therefore, merely enumerated them (*vid.* Table V) and have devoted the pages to the better purpose of tracing the mental processes of the world's leading surgeons in their journey towards the goal, hoping that it may be profitable and enjoyable to my readers to learn from the lips of the men who have created and perfected the operation for goitre the story of their progress. I have told in the foregoing pages enough to indicate that so far as the art of operating is concerned nothing of real significance was contributed by any of the four countries—France, Italy, Great Britain and America; but more important than the art was the science, the contributions to which from Great Britain and America made progress in surgery possible. Prior to the introduction of anaesthesia, little surgery was done in the world; and after this, when operations soon had multiplied in every land, sepsis reared its head, and finally so dominated the situation that in some countries, particularly those where operating was done on the largest scale, hospitals had to be destroyed and operations, if done at all, had to be performed in pavilions. It was the fear of haemorrhage that deterred surgeons from operating for goitre, but it was from sepsis that most of the patients of the Swiss, Austrian and German surgeons died.

From the canvass which portrays the work of the resolute men, who at the outset went to the aid of the gasping victims of goitre, the figure of Hedenus looms in my eyes perhaps largest. At the very beginning of the 19th century he extirpated six suffocating goitres without a death, a feat which was not repeated for three-quarters of a century.

J. A. W. Hedenus (Dresden). *Ausrottung der Schilddrüse.* Journal d. Chir. u. Augen-Heilk., Berlin, 1821, Bd. ii, p. 237.

Hedenus begins his communication thus:

"Although I have six times and successfully performed this operation, which on account of the arteries, veins and nerves is so difficult and dangerous, I will relate the story of only the most important one, namely the second, notwithstanding the fact that the third, fifth and sixth were not less significant.

"That the operation belongs to the most difficult of surgical undertakings is evident from this, that several authors maintain it is unachievable; thus Wichman says in his *Diagnostik,* 'To attempt to extirpate a goitre as one would a scrofulous gland is equivalent in German to nothing less than literally to cut off the neck.' Even the great and, for German surgery, unforgettable Professor Richter in Göttingen, who for every physician and surgeon in Germany is immortal, assured me verbally that on account of its great danger he has never performed this operation and never will."

P. 240: "Inasmuch as all of these patients operated upon by me would have died of suffocation, ... I resolved to interfere, notwithstanding the risk, and for the following reasons: In the first place, to relieve them

of life-threatening danger and of sore distress; and, secondly, in order to demonstrate to my students what an operator who is endowed with courage, determination, calmness, perseverance and patience, and who possesses the requisite anatomical and surgical knowledge, can accomplish with the bistouri for the good of mankind."

Abstract of Hedenus's Case 2: Male, aet. 21. Large goitre which caused rattling in the throat.

Operation, October 8, 1800.—Vertical midline incision. In liberating the tumor sufficiently to expose the superior and inferior thyroid arteries * "64 arteries were tied." The thyroid vessels were then doubly ligated and divided. The difficulties increased as the operation progressed, because always new arteries had to be ligated in the depths of the wound. Since arteries as large as the radial continued to present themselves *the pedicle of the tumor was transfixed with a double ligature and tied off.*† The goitre was then cut away without further bleeding. The operation required 1½ hours.

Stormy convalescence. Difficulty in swallowing, hoarseness, paresis of right arm, chills and high fever, delirium, extensive infection of wound, abscesses under scapula and haemorrhage from the stump on the eighth day; on the 17th day severe haemorrhage from the upper angle of the wound. On the 23d day the patient was permitted to get out of bed. Ultimate recovery.

I doubt if we can realize today what it meant in the year 1800 to perform in a fairly bloodless manner and without anaesthesia an operation of such magnitude.

Considering the circumstances, are not, perhaps, these operations of Hedenus for goitre performed about one and one-quarter centuries ago as great as, if not greater than, any surgical accomplishments of the present day? We have only to bear in mind the warnings against performing this operation, from one-half to three-quarters of a century later, of Dieffenbach, Liston, Velpeau, Gross, Mott and many others, including surgeons even of our time, and to recall the sensation made in this country by the relatively crude operations of the courageous Warren Greene, 70 years after Hedenus, to comprehend in some measure the credit due to this surgeon.

In striking contrast to the admirable operative procedures of Hedenus are the detestable performances of Klein (1815).[134] Do the chronicles or surgical horrors record a more revolting tragedy than the one staged by Klein in the case of the deaf and dumb child? The comments of this exul-

* It seems to have been the aim of Hedenus to tie the thyroid arteries at as early a stage of the operation as possible.

† Italics mine (W. S. H.). This method of treating the so-called pedicle was followed in all countries for about 80 years. For notable exceptions see cases of Desault and Dupuytren.

tant operator on his foolhardy achievement accord well with his doltish savagery.

Dr. Klein (Stuttgart). *Ueber die Ausrottung verschiedener Geschwülste, besonders jener der Ohrspeicheldrüse und der Schilddrüse. Ausschälung der Schilddrüse.* Jour. d. Chir. u. Augen-Heilk., Berlin, 1820, Bd. i, 120.

Case 1.—Deaf and dumb boy, aet. 11 years. Delicate and very small for his age.

"Finally, in June, 1815, the child was brought to me, and I was astonished, as was everyone who saw it, at the remarkable nature of the growth. It occupied the whole of the left side of the neck extending from the ear to the third rib. Blood vessels, finger-thick, were spread over the surface of the tumor, which on account of its weight rather than from adhesions was quite immovable. At its base the transverse diameter was 6 inches, the vertical, 5; its transverse arch measured 16 inches, its longitudinal, 11½. It was very nodular, and here and there pulsation could be felt in the arteries which entered it. Since in this case no other measure was possible, I decided upon extirpation in spite of the great difficulty and the manifest danger. I had to deal here with a child who could in no way be made to comprehend anything, who even while measurements of the tumor were being taken was unmanageable.

"The child was placed on a table because I dared not let him sit on the lap of an attendant, since his breathing would have caused motions interfering with operative precision. One assistant held the head, two assistants, one on each side, held the arms, and two, the hands and feet. I stood on the right side, rapidly made two oval cuts over the tumor, and on each side dissected up a flap. From the many large vessels, everywhere cut, there came, as was to be expected, a considerable quantity of blood, but always fingers enough were ready to arrest the haemorrhage. However, in the brief period, over ½ pound of blood was lost. The left lobe was quickly cut away; this could be done the more readily, inasmuch as the incisions crossed above and below. An assistant now pressed a cork firmly upon the carotid above the collar-bone. I pulled the tumor with the fingers forcibly upwards and, keeping always on the under surface, using sometimes the fingers, sometimes the knife, and sometimes its handle, separated it from the entire length of the carotid, from the whole trachea and larynx and from below upwards shelled out the right lobe. To do all this required—who would believe it?—1½ minutes. Even I would not have believed it, for the time seemed to me very long, especially when I was stripping the tumor from the carotid. But several onlookers who counted the seconds agreed as to the time elapsed.

"To our amazement, no bleeding followed; even the divided thyroid arteries did not bleed, and except for the haemorrhage from the divided superficial veins very little blood was lost during the operation. We were still more astonished to find the child lying there without a sign of life. I ordered quickly a sponge dipped in cold water to be placed on the wound and the face to be dashed with cold water; thereupon deep spasmodic breath-

ing took place. I regarded it as a deep swoon. The boy let out a cry only when the first cut was made, at any rate no one heard any further sound, and this was excusable considering the concentration of the operation. For about three-quarters of an hour the body was rubbed and brushed and splashed, and stimulants and all the reviving means employed; during this time the heart, and occasionally also an artery, could be felt to beat feebly, but the inspirations gradually decreased in frequency, and then without the slightest convulsive movement life was extinguished.

"The necessary routine precautions to be observed in case of possible return to life were prescribed, but the child remained dead.

"Now arose the question, what could have been the cause of death? Loss of blood it certainly was not, nor was it injury to the carotid; injury to the vagus could with equal certainty be excluded, because in the first place this is not fatal and, second, it presents a different picture. Entrance of blood into the larynx either by mouth or through an injury of the same or of the windpipe it could not be, otherwise there would at least have been violent coughing and a streaming out of air. If we consider, furthermore, the short duration of the operation, the manner of death becomes more inexplicable.

"The next morning I examined the body. The edges of the wound all the way up to its upper angle could have been beautifully brought together. The carotid, the vagus, the vena jugularis were throughout their entire length covered with a thin layer of connective tissue. The sternocleidomastoid, pushed far to one side, was cleanly dissected, but not injured. At the exit of the carotid from the aorta I made an incision and injected water upwards several times, but not a drop escaped from the carotid; it did, however, from the dilated thyroid arteries which had been cut off so long that their ligation would have presented no difficulties. The nervus vagus was dissected throughout its entire length and found to be nowhere injured—indeed it could not have been because the carotid was intact. Alongside of the carotid were four cervical vertebrae still covered with fascia (so deep had the tumor extended); the esophagus was bared for the same distance, and bared also were the windpipe and larynx which had been forced to one side. I slit them from below upwards through the glottis, but not a drop of blood did they contain. How difficult the enucleation must have been one can now comprehend, and one can conceive also how beautifully and rapidly the operation must have been performed.

. . . . "At any rate, the connoisseur in passing judgment upon a faultless operation is influenced not by the result but by the artistic manner of its performance; and in the present case I have for myself no reproach, but only congratulation.

. . . . "This is the first extirpation of a thyroid gland of this size which has come my way. I have never seen the operation performed; nor have I ever practised it on the dead body,* for the opportunity never presented, or else, perhaps I did not embrace it. It would be presumptuous to make generalizations from one case, but I openly confess that I cannot understand why one stands in such awe of haemorrhage and I admit, just as freely, that I was not in the least apprehensive on this score, and that I performed this

* Unless, possibly, this operation was on the dead body (W. S. H.).

operation with absolute courage and with the consciousness that happen what might I should certainly be equal to the emergency.

. . . . "In all cases the thyroid arteries must be cut; in the first instance, the trunks; in the second, the branches. In the case of the latter, gum arabic, combined with continuous pressure against the cervical vertebrae and vigorous constriction of the basal surface, can be relied upon. In regard to the ligation of the arterial trunks as well as of all other arteries whether of skin or muscle which must necessarily be cut, I confess that I would not follow Desault or Richter among others who advise before ending the operation to tie each divided artery. The latter, in his lectures, gave this advice for all operations, even in ablations of the breast. I, too, followed him in the beginning, but soon wrote to my venerated teacher that, for various reasons, I should no longer follow his advice, and since then, too, I do so no more and find that I get along better."

Case 3.—Baron von T., aet. 22. At the age of 14 years a circumscribed hard nodule appeared in the lower part of the right thyroid lobe. Increasing in size it finally caused difficulty in swallowing and a feeling of pressure in the head. He became despondent and resigned from the army. Other forms of treatment having failed to give relief, he was told that an operation of a dangerous nature alone offered hope. His misery became unendurable when he had "the frightful misfortune to shoot to death in its cradle the only child of a much-beloved brother. Thereupon, overruling all my objections, he insisted upon having the operation performed. Over the inner end of the right collar-bone, under the sternomastoid muscle, I found a hard mass the size of a dollar. This disappeared completely at times and could only be recovered by lateral rotation of the head and repeated attempts to swallow, combined with the pressure of the neck against the clavicle. If seized quickly with the fingers one could force it up to the middle of the windpipe. The patient made his will, and insisted upon having the operation performed, so I resolved to do it notwithstanding its dangers. On the 4th of April [year not given] I performed the operation, to describe which will be as difficult as was the procedure itself. My intention was to cut directly down upon the upwards dislocated nodule. This was unachievable because the patient could not endure the pressure necessary to hold the tumor in position. I drew up, therefore, a fold of skin and made through it a 4-inch incision parallel with the sternomastoid muscle and down to its tendon. But now the lump could not be felt; it had withdrawn itself behind the collar-bone so far that I could barely touch its upper edge. It is really difficult to understand that so many futile attempts had to be made before the tumor could be seized. Finally, after various twistings of the head and repeated efforts of the patient to swallow, I succeeded in catching it with a double hook in one of the moments when it bobbed upwards. Now swiftly I transfixed it with a needle, made a sling of the thread and in this way held the hard lump. The overlying muscles, the sternomastoid included, were divided. But the omohyoid, which happened to be pierced by the loop of thread, I cut in two, because at the moment the latter was more important for me than the former.

"Partly by means of the very useful loop of thread, partly by the hook and partly by the fingers I succeeded in pulling forward the tumor, but as

I progressed I had to cut with greater caution. The deeper I went the more I had to use blunt instruments. And now whether I pulled or dissected, the patient suffered either indescribable, transitory pains in the head, or spasms of the diaphragm, or a painful, uncontrollable tendency to swallow and vomit, so that quickly I had to change the direction of the tug or of the dissection; the enucleation was thereby complicated, and the more so because the tumor now proved to be much larger than I had thought. In the course of the delivery the superior thyroid artery was cut through and spurted smartly; but as I intended to bring the operation rapidly to a finish, the haemorrhage caused me no concern. After I had freed in this manner about two-thirds of the hard mass, the consequences of the tugging on the vagus and phrenic nerves became more and more pronounced and hence on this account and also because the operation had been so prolonged and the haemorrhage so great I concluded to tie off the tumor and cut it away distal to the ligature. But as I tightened the loop and thus pressed forwards the tumor, I squeezed it entirely free from its connections: the loop glided behind the growth which almost delivered itself as I continued to draw up the knot. Now, thought I, the game is won and I can alter my plans. Accordingly, I sliced away the tumor, but at the same time cut in two the unusually dilated inferior thyroid artery, whereupon the loop of thread followed after. The haemorrhage which ensued can be imagined. To ligate was out of the question—the hole from which the bleeding came extended 2 inches below the clavicle (to this depth I could pass my index finger). Pressure could not be brought to bear, the operation had lasted a quarter of an hour, the patient's condition was bad, the sponges employed became instantly soaked through with blood and cast out. It was high time to act promptly. There remained only one thing to do—to ram a sponge the size of a fist into the hole and to keep up the pressure on it by six assistants in turn. This availed; the bleeding ceased and therewith the consternation of all of us, who believed that I had severed the carotid, so great was the haemorrhage.

"There is nothing especial to be said about the dressings and the treatment. On the second day there was considerable fever; there developed a continuous cough, producing irritation with a very disagreeable sensation in the region of the diaphragm, and associated with this a distressing shortness of breath which compelled the patient to remain in a sitting position. These symptoms were clearly referable to the irritation of the nerves of the diaphragm caused by the sponge. It was surprising that neither the swallowing nor the speech was in the least affected.

"Each day the suppuration increased, but the sponge remained fixed, nevertheless. One dared not make forcible attempts to withdraw it, and I was six hours distant. On the ninth day the sponge began to show up above the surface of the wound; by cutting away the projecting part, by gently pulling in one direction and another, by twisting it on its axis, etc., I finally succeeded in bringing out the sponge which was indescribably swollen. Only an insignificant haemorrhage, from the edges of the wound, followed its withdrawal. Without exaggeration the sponge was one-third larger than at the time of its introduction; a more precise estimate of its relative size I am unable to give because the instant it was laid aside a hunting dog de-

voured it. (It is of course a digression, but still sufficiently remarkable to deserve mention, that this very large sponge did the dog no harm. We never knew whether the dog disengorged the sponge or not.)

"In the third week the wound was healed and our patient is one of the happiest of men."

VICTOR VON BRUNS. Almost the entire story of progress in the surgery of the thyroid gland for the third quarter of the last century may be found in the operative work of Victor von Bruns. In 1851 he removed successfully several nodules, from the size of a hen's egg to an apple, from the isthmus and both lobes of the gland. His second operation was in 1856; the patient died of septicaemia. Then each year, with few exceptions, he had either one or two cases until 1876 when he operated upon six. For 1862, 1869 and 1870 no case is recorded, but for 1864 there are three—28 cases * in all. Most of the operations were enucleations for "parenchymatous cysts"; two were total excisions (operations of great magnitude) for carcinoma. Of the six deaths, five were due to septicaemia and pyaemia, and the sixth to secondary haemorrhage, also, of course, the result of infection. Excluding the cases of carcinoma, there were only four deaths in 26 cases. The operation upon one of the carcinomata (1874) required four hours and 120 ligatures. A large piece of the left common carotid was excised. On the fourth day after the operation there was profuse secondary haemorrhage from the left common carotid which was controlled for three days by compression with the Ehrlich crutch. On the ninth day there was a fatal haemorrhage from the same vessel. Thus, except for infection, von Bruns would, probably, have had no fatality to record from operation upon the thyroid.

It is noteworthy that, in contrast to other surgeons of his day, as early as 1868,† he used the cutting edge of the knife to dissect, carefully, the tumor from the trachea.

Bruns exercised great care in controlling haemorrhage. Operations which he considered quite bloodless might not, however, be so regarded today. He did not, apparently, discover that the blood vessels of the thyroid gland had a distribution which varied little from a norm; nor, indeed, did Kocher until some years later (1883)[189] direct attention to the regularity in the arrangement of the arteries and veins and recommend ligation of the thyroid arteries as a step in the operation preliminary to the excision of a lobe. Bruns ligated

* In Süskind's paper[880] these cases are tabulated, and 10 of the most important ones are recorded in detail.

† Desault in 1701 and Dupuytren in 1808 (*vid.* table) carefully cut the isthmus away from the trachea. Then for 60 years and more, surgeons of all countries, fearing to dissect the isthmus from the trachea, treated it as a pedicle, with clamp and cautery, écraseur, transfixion, ligatures, etc.

vessels only as they presented, liberating first the more loosely attached parts of the tumor.

His dissection was made bluntly, sometimes with specially designed tips which could be forcibly separated by pressing the handles of his polyspeculum; or, the tissues to be divided were canalized layerwise with Cooper's scissors, the fingers or the handle of a knife. Along the passage thus made a ligature-needle would be passed, and the tissues, including vessels, would be divided between the two ligatures.[63]

I was pleased to find in Süskind's dissertation (*l. c.*, 1877) a list of instruments employed by Bruns in his operations for goitre: "Several pointed bistouries, several forceps * (preferably toothed forceps), Cooper's scissors, one aneurism-needle (preferably the blunt, ligation-needle of Bruns), a Muzeux's hooked forceps † (Vulsella) or a fenestrated forceps, ligature-rods of Gräfe or Dupuytren, catgut and silk, sponges, water, blunt hooks."

No mention is made of artery forceps; this may be an oversight, for Bruns in his *Handbuch der chirurgischen Praxis,* vol. i, p. 29, says: "The ordinary forceps which are closed by finger pressure ‡ can be held permanently closed by various devices, among which the Schiebervorrichtung of Fricke has proved to be best suited to the purpose. Most frequently such lockable forceps are employed for the tying of bleeding arteries and hence have been named artery forceps, although they are often used to grasp the cut edges of the skin or mucous membrane, or bits of sponge with which blood and mucus are wiped away. For all these purposes I use preferably the forceps represented in Fig. 37" (*l. c.*, p. 29). Another forceps used by Bruns is figured on p. 240 of his book.

The above quotation convinces one that the artery forceps was not used very frequently, and that the idea of leaving two or more clamps hanging in a wound had not been evolved.

The contributions of Billroth to the surgery of goitre would not from his own pen seem to be nearly so important as Kocher's, but the significance of his work is reflected in the writings and contributions from his school—of his assistants, notably Wölfler, von Mikulicz, von Eiselsberg, von Haberer and Schloffer.

Wölfler's voluminous and classic monographs on the development and structure of the thyroid gland and of goitre [368, 370] resulted from the study of Billroth's operative material. Von Mikulicz gave to the world his method of resection of both lobes; from von Eiselsberg and from his school has come

* Dissecting forceps is meant.

† Vulsella forceps was used for the hard tumors and a fenestrated forceps for the soft ones.

‡ Our thumb forceps.

fundamental experimental work on transplantation of the thyroid and parathyroid glands; von Haberer has greatly stimulated interest in the thymus, and by his operative studies on the human subject has lent support to the views of Garrè and Rehn and of Garrè's assistants, notably Capelle and Bayer. Schloffer has developed an operation for goitre which closely resembles mine. In the early eighties Billroth had operated upon more cases of goitre than any one in the world, had emphasized the danger of wounding the recurrent laryngeal nerve in performing the operation of lobectomy, and had furnished many sad examples of tetany consequent upon total extirpation of the gland.

THEODORUS BILLROTH.* *Chirurgische Klinik, Zürich, 1860-67.* Berlin, 1869, p. 167.

"Fasse ich das Resultat meiner Kropfoperationen zusammen, ohne Rücksicht auf die besonderen Verhältnisse der einzelnen Fälle, so ist es kurz folgendes:

	Mal	Geheilt	Gebessert	Ungeheilt	Gestorben
1. Cystenkröpfe:					
Punction	2	..	..	2	..
Punction, Drainage	1	1	..	..	..
Incision, Vernähung von Cystenwand und Haut	10	8	..	..	2
Punction, Iodinjection	20	18	..	2	..
2. Feste Kropfgeschwülste:					
Subcutane Zerreissung	3	1	1	1	..
Aetzung	1	..	..	..	1
Tenotomie	2	..	1	..	1
Exstirpation	20	12	..	..	8
	59	40	2	5	12"

Eagerly I have refreshed my memory of Billroth's experiences with the surgical treatment of goitre in the eventful days of his directorship of the surgical clinic of the University of Zürich; and I wish there were space to quote him at greater length.

Billroth's account of his treatment of tumors of the thyroid by operation, "subcutane Zerreissung," which he performed in only three cases and abandoned after the first fatality, strikingly testifies to his earnest effort

* On April 1, 1861, in his 31st year, Theodorus Billroth assumed the responsibilities of the surgical clinic in the University of Zürich. On August 21, 1867, he was called to the chair of surgery in Vienna.

to cure his patients, to his zeal in carrying out personally every detail of the treatment, and to his desire at first to avoid operation with the knife. Of the 20 extirpations which he performed, eight of the patients died, although 18 of the operations were merely enucleations of circumscribed growths. In one case (No. 16) he performed successfully a one-sided lobectomy, and in one (No. 17) he excised the whole gland, with fatal result in 48 hours.

Case 17 (*l. c.*, p. 176).—"Verena N., aet. 29. Excessive dyspnoea. The trachea, especially at its entrance into the chest, was compressed by many nodules in the thyroid gland. Extirpation of the entire gland. After the operation the patient could not swallow. Collapse and death in 48 hours. At the autopsy the right recurrent laryngeal nerve was found to be included in the ligature about the inferior thyroid artery."

P. 179: "To him who has had little practice in these operations it can easily happen that he removes the entire half of the gland instead of merely the tumor whereby the operation becomes very complicated and more dangerous. The extirpation of the entire gland is not so exceedingly difficult and can be accomplished without great bleeding; *but whether human beings can survive it has not yet been determined.*" *

The deaths following Billroth's operations were due to infection. One patient (No. 17), the only double lobectomy, died of "collapse"—probably from haemorrhage. Thus Billroth, who later, in Vienna, was to accomplish so much in the operative treatment of goitre, contributed little to its advancement during his six and a half years in Zürich.

Billroth's Clinic in Vienna. Reported by Anton Wölfler, *Zur Chirurgischen Behandlung des Kropfes.* Arch. f. klin. Chir., Berlin, 1879, Bd. xxiv, p. 157.

Believing that the operative methods of treating the various forms of goitre have been perfected, Wölfler thinks it would be unnecessary to write further on this theme were it not for the new questions raised by the advances made in the treatment of wounds. He confines his report to the consideration of cases of goitre treated in the clinic of Billroth in the academic year of 1877-78. A great number of patients with so-called parenchymatous goitres were treated with injections of iodine. Among these were not only the "diffuse hypertrophic forms" which Kocher considered the only ones suitable for iodine injections, but also soft goitres ("struma follicularis mollis") and other varieties "which probably stand midway between the two." Certain cysts responded to iodine injections in a remarkably favorable manner; others were uninfluenced by this treatment. Unqualifiedly condemned is the method of Mackenzie [227] (injections of chloride of iron) on account of the danger of embolism.

* Italics mine (W. S. H.).

Wölfler reviews the use of the setaceum, the wick, the hair seton, cannula, incision, thorough drainage, etc., and concludes as a result of their experience with the Lister treatment that incision with drainage of cysts has a promising future.

The physical characters of the goitre particularly interested the surgeon. Was it solid or cystic or vascular—a tumor suitable for parenchymatous injection, "Zerreissung," seton, drainage, enucleation, or to be let alone?

It interests me to note that Wölfler strongly recommends the use of penghawar djambi * for checking haemorrhage in papillary cysts which bleed after incision. During this and the following year (1879 and 1880) I studied in Vienna, and observing that penghawar djambi was used quite frequently in the clinic of Billroth, I obtained some of it from Wölfler, who only a few years ago very kindly sent me a fresh supply of this curious natural styptic wool. I have never had occasion to use it.

Wölfler asks if it might not be justifiable to extirpate cystic goitres notwithstanding the vehemently adverse pronouncement of Gurlt and others and, finally, reports the results of seven extirpations of goitre with the antiseptic method of Lister. Prompt healing was obtained in every case. He wonders why so few operations upon the thyroid gland had been undertaken in America and France; and particularly in England, where ovarian cysts had been removed one hundred times as frequently as goitres; "whereas with us the contraindications are becoming constantly fewer and the number of operations are steadily increasing." He finds the answer in the better control of haemorrhage, in the antiseptic technique and in the new indication for operation based on the teaching of Rose that the tracheal rings become softened by the pressure of goitres. The intimation that the surgeons of England, France and America were not so advanced in the art of controlling haemorrhage and in the science of the treatment of wounds was fully justified. Whereas most of the better surgeons of Germany and Austria and Switzerland promptly and eagerly accepted the teachings of Lister there were few in England, France or America who did so until nearly a quarter of a century later. Indeed, our surgeons were novices as compared with the Germans in the art as well as the science of surgery in those days.

But Wölfler's memory seems to have been short, for hardly more than a year had passed since Billroth, ever mindful of his disastrous experiences of the previous decade in Zürich, had ventured to operate again upon goitres; and the acquired confidence was based chiefly on results obtained with the antiseptic method of Lister, a gift from England.

* Paleae haemostaticae. Root hairs of the East Indian bullock tree (Baumfarren).

In this series (1877-78) of Billroth were, for the first time, cases operated upon for cosmetic reasons and for moderate difficulty in breathing—"none because life was threatened." Also a definite method of operating had been evolved. The incision was made along the sternomastoid, and the division of this muscle abandoned. The sternohyoid, sternothyroid and usually the omohyoid muscles were divided transversely. The capsule was slit up on a grooved director, its veins being avoided as much as possible.

Clamps had come into use and Billroth was evidently learning some of the various purposes which they were to serve; for example, he divided tissues containing vessels between two of them and would leave a number hanging in the wound. Where the binding structures were short, an aneurism-needle was employed. The thyroid vessels were not sought for and isolated; all vessels were tied *en masse* as encountered. "The searching for special vessels did not seem worth while, because the operation would thereby be lengthened and be made bloodier than it was when step for step ligatures *en masse* were applied. And, moreover, it seemed questionable whether wound surfaces would unite primarily if 60 to 100 ligatures remained and in part came to be opposed to one another." In order to avoid the danger to which tying *en masse* exposed the recurrent nerve, Billroth included less tissue in the ligatures when working in the vicinity of the inferior thyroid artery and ligated this artery separately, as it was met with in the course of the operation.

Abstracts are given in this paper by Wölfler of the seven cases operated upon by Billroth in the academic year 1877-78.

These records have especial interest for me, because they tell the story of the early experiences with Listerism of Austria's great surgeon, and also for the reason that I was studying in Vienna (1879-80) and occasionally attended the clinic of Billroth at this period when the science of surgery was beginning to reveal promises of a marvellous future.

I regret that the early operations on the thyroid gland by Billroth are not reported in greater detail. From the data given I am quite sure that lobectomy, more or less complete, was performed on one side in three of the cases (Nos. 1, 6 and 7), and extirpation of a circumscribed tumor in three (Nos. 2, 3 and 4).

In case No. 2, a cystic papillomatous adenoma, the haemorrhage was so great from one of the deep-lying cysts that complete extirpation was impossible. The bleeding was stopped by stuffing with penghawar djambi.

In case No. 5, total extirpation of the gland was probably made, at least in the sense that no thyroid tissue was left unremoved. Both lobes had apparently been replaced by adenomata. The left recurrent nerve was paralyzed as a result of the operation.

In case No. 7, "Struma carcinomatosa," there were "ganz enorme Blutungen." Sudden collapse occurred from the entrance of air into a vein, but the patient recovered and the operation was completed. The internal jugular vein had to be ligated.

Billroth's Clinic in Vienna. Reported by Anton Wölfler. *Weitere Beiträge zur chirurgischen Behandlung des Kropfes.* Wien. med. Wochenschr., 1879, Bd. xxix, pp. 733, 758, 782, 810, 831.

This paper followed promptly the preceding one on the same subject and is continued through five numbers of the Wiener medicinische Wochenschrift. Nine more cases (Nos. 8 to 16) of successful goitre-extirpation are reported.

With the growth of Billroth's experience in operating and in the antiseptic treatment of wounds his confidence keeps pace, and we find in this report operations of greater magnitude than before—three total extirpations and one lobectomy plus an enucleation on the opposite side. Wölfler contrasts the work of his countryman with that of the surgeons of other lands, condemning particularly and quite properly the operative method of Warren Greene (*l. c.*), which he terms, not inaptly, an "énucléation à tout prix," and bestowing insufficient praise upon Patrick Watson (*l. c.*) whom, true to the error of Süskind, he credits to England instead of to Scotland. He justly criticizes Watson's extracapsular method, but he should have borne in mind the fact that Watson was scoring five consecutive recoveries from lobectomy and total extirpation of the thyroid gland (1871-74) in the years when Billroth, discouraged by the memory of his unfavorable results with operations upon the thyroid gland in Zürich (1860-67), was resting on his oars so far as thyroidectomies were concerned. Undoubtedly, Billroth's method in 1878 was better than Watson's in 1871-74; and in justice to Billroth it must be recalled that his deaths in Zürich were with one exception due to sepsis. On the other hand, Watson had to work quite without artery clamps; whereas Billroth, thanks to intercurrent inventions and to greatly increased operative practice following the advent of antiseptic surgery, had become, in 1878, fairly conversant with their uses.

We should particularly bear in mind, also, the important fact that in German-speaking countries patients flowed in great streams to the university hospitals and that Billroth was director of Austria's greatest surgical clinic; whereas in Great Britain adequate opportunities to operate usually came late in his life, if at all, to the surgeon, and the number of cases at his disposal was pitifully small. Furthermore, Billroth's surgical activities were always in countries where goitre is prevalent.

Case 11 (*l. c.*, p. 760).—*Totale Exstirpation einer strumösen Schilddrüse, definitive Heilung nach 20 Tagen.* This is Billroth's first case of tetany, and his first total extirpation with successful result. Wölfler writes of it:

"This case yields us several facts of clinical interest: it demonstrates that total extirpation of the thyroid gland seems under certain circumstances not only to be demanded, but also that the operation may be performed with as little danger as the simple shelling out of the goitre.

. . . . "It was further noteworthy that after extirpation the patient's voice became hoarse. Dr. Catti ascertained by laryngoscopic examination that there was right-sided paralysis of the vocal cord. Besides this, other symptoms appeared which led us to conjecture that these symptoms might be connected with the loss of the thyroid gland.

"A few days after the operation the patient surprised those around her by her singularly restless and dissatisfied demeanor; she complained continually of sleeplessness, and importuned constantly the physicians and attendants to do something to relieve her since her condition was worse than before the operation. Since the local and general conditions seemed to leave nothing to be desired, it was thought that she was feigning the symptoms of which she complained.

"On the evening of the sixth day the patient was seized with convulsions of the extremities, without losing consciousness. She was greatly agitated, cheeks red, pupils dilated, respiration labored, all extremities cool, pulse 65; at the same time she complained of pains in the head, dazzling before the eyes, roaring in the ears and a feeling of pressure in the chest.

"On the 19th of November the patient had a second attack, and on the 21st, a third; but these last were much milder than the first attack. The whole clinical picture tallied so completely with that which had been observed by Landois, and besides by Hermann and Escher in the experimental production of hyperaemia of the brain, that one must conclude that the conditions of the circulation of the blood in the brain had undergone a change by the complete removal of the thyroid gland. Even though the correctness of this conception cannot at present be denied, it is, nevertheless, questionable, since the patient suffered from an anteflexion of the uterus, and her ovaries, palpable per vaginam, were sensitive to pressure—symptoms suggestive of hysteria. There remained, nevertheless, as cause for suspension of judgment, the asseveration of the patient that before the operation she had never suffered from such attacks, and also the circumstance that during the subsequent four weeks of her stay in the hospital she was quiet and contented, that the attacks were not repeated and that sleep returned."

The symptoms described by Wölfler in this case seem clearly to signify tetany—the first, following operation, that I have found recorded. Indeed, so far as I am able to judge from a careful reading of the published cases, no one except Sick (*l. c.*, 1867) and Kocher (two cases, *l. c.*, 1874) had hitherto excised the thyroid gland so radically. The parathyroid glandules,

consequently, had probably never before been destroyed unless possibly in Billroth's case of Verona N. (*l. c.*), a patient who died too soon (48 hours) after operation for tetany to have developed.

"One of the patients (No. 16) of the series had to be tracheotomized in the course of the operation. In the act of dissecting off the isthmus the softened trachea suddenly bent on itself at an angle, the patient ceased to breathe, and all efforts to restore the respiration being fruitless, the trachea was opened and the operation completed. By subsequent laryngoscopic examination it was discovered that there was paralysis of the left vocal cord; nevertheless, the movements of the epiglottis remained normal. Comparing this observation with that made before operation, it is found that the left vocal cord, which before the operation had acted more sluggishly than the right, was paralyzed, and that the epiglottis in this case was not affected by the paralysis. We shall return later to the explanation of this peculiarity.

"Four weeks later, when the wound in the trachea was cicatrized and the patient had begun to speak aloud, another laryngoscopic examination was made. It was interesting to discover that the opening of the previously compressed and softened trachea now appeared perfectly normal and that the closure of the glottis was now exact."

Résumé by Wölfler (*l. c.*, p. 832) of the 16 Cases of Billroth's Antiseptic Series

"In the last year and a half, as has been stated, Professor Billroth performed 16 operations for extirpation of goitre with antiseptic methods. In all the cases healing took place in from one to five weeks.

"The size of the goitres varied from that of a walnut to that of a man's head and over.

"The age of the patients was from 19 to 65 years.

"Total extirpation of the affected thyroid gland was undertaken in three cases; in one case the middle and right thyroid lobes were extirpated; in all the remaining 12 cases the tumor only was excised.

"The operation was most frequently performed on account of increasing difficulty in breathing; in about five less important cases it was for cosmetic reasons, and in some cases for both.

"In the case of a woman with papilloma of the thyroid gland severe haemorrhages necessitated rapid extirpation.

"The technique of the operation was, aside from some unessential variations, in most of the cases the same, and can, therefore, be briefly summarized as follows:

"1. Exact cleansing of the field of operation;

"2. Under thymol spray a linear skin incision along the inner edge of the sternocleidomastoid muscle (in one case a flap was made);

"3. Division of the superficial and deep fascia of the neck on the director; double ligation of the superficial veins. For all ligations silk, boiled in carbolic acid solution according to the method of Czerny, was used, catgut, never;

"4. Splitting of the capsule on a director, or, when many veins were encountered, division between two clamps;

"5. Attempt to free the goitre bluntly; if this does not succeed;

"6. Divide all obstructing bands between two artery clamps and ligate *en masse;*

"7. Ligation of the superior thyroid artery; excision of the goitre from above downwards; isolation and ligation of the inferior thyroid artery;

"8. If total extirpation is undertaken, the same procedure is followed on the opposite side;

"9. Careful excision of the goitre with special attention to the freeing of the isthmus from the trachea; here, also, two clamps may be employed; or, if the adhesion is slight, an aneurism-needle may be passed through on the proximal side and a clamp applied peripherally to the goitre;

"10. Thorough washing out of the wound with thymol; introduction of two to three medium-sized drainage-tubes; stitching with two to three plate-sutures and a corresponding number of interrupted stitches;

"11. Application of an antiseptic dressing covering the chest, neck and head;

"12. The drainage-tubes and the plate-sutures are removed on the third or fourth day, the interrupted sutures on the sixth to the eighth day; later, the fresh scar is covered with an ointment bandage. As several of the above-mentioned procedures which have already become typical of our clinic have been described in our previous communication, there remain only a few other matters to be discussed in detail."

Paralysis of the Vocal Cords Following Goitre-Extirpations *

"It appears quite remarkable that in each of the last six cases, in which Dr. Catti made careful laryngoscopic examination after operation, a one-sided paralysis of the vocal cord was observed. In one case (No. 11) we could not be sure that paralysis of the vocal cord had not been present before operation; and also in case No. 16 it was noticed prior to operation that the left vocal cord, which became paralyzed later, acted more sluggishly than the right (atony of the vocal cord); in the other four cases, however, of one-sided paralysis of the vocal cord closure of the glottis was exact before operation.

"It should be emphasized that in each of the three cases of total extirpation of the thyroid gland paralysis of the vocal cord occurred on one side only.

"In the first days after operation a paralysis of the recurrent nerve may be suspected if the patient chokes in attempting to swallow fluids; this indicates that the epiglottis is no longer able to close the glottis accurately.

"Fortunately these one-sided paralyses of the epiglottis improve markedly after the first or second day. If such patients are later examined laryngoscopically, it is seen on phonation that only that edge of the epiglottis sinks which does not correspond to the paralyzed side and that the epiglottis must make a sort of twisting movement in order to close the entrance of the larynx. It was also noticed in most of the patients that in

* *L. c.*, pp. 833-6.

the course of four to six weeks the voice became less hoarse, or that the hoarseness almost entirely disappeared. This improvement in the speech, which is noticed in paralysis of the recurrent nerve produced by other causes, is not due to the restoration in so short a time of the function of the paralyzed vocal cord, but to the fact that the healthy cord, being approximated gradually to the paralyzed one, effects an almost complete closure of the glottis; the voice, then, though not so hoarse, is still weaker than normal. This improvement in the speech may be the reason why so few authors have thought it necessary to make an examination of the vocal cords after extirpation of a goitre.

"The fact that one-sided paralysis of the recurrent nerve improves in this fashion is confirmed by many other observers (Türk, Mayer, Gerhart and others).

"A case very interesting in this connection was published by Klein (Jour. von Gräfe-Walther, Bd. i, p. 130) in 1818: A young man had a goitre the size of an apple removed. During the operation he suddenly became speechless; thereupon the tumor was quickly ligated and cut off. The loss of voice lasted for three weeks; by degrees the patient began to speak again, 'his voice had changed into a harmonious bass.'

"It should be noted especially that sometimes a swelling of the arytenoid cartilage persisting for a time after operation likewise causes temporary incomplete closure of the glottis.

"The cause of these paralyses of the vocal cords is easily explainable if one remembers that in ligating the inferior thyroid artery the trunk of the recurrent nerve may be caught, ligated and cut through.

"This generally accepted explanation is justifiable only when, as in the three cases described by us, the one-sided paralysis is complete, where not only the one vocal cord, but also the corresponding half of the epiglottis is incapable of functioning.

"Ligation of a recurrent nerve in dogs produces paralysis not only of the vocal cord and the arytenoid cartilage, but also of the corresponding half of the epiglottis (Navratil, Berlin. klin. Wochenschr., 1871, p. 394).

"Therefore, if the vocal cord only is paralyzed, then the trunk of the recurrent nerve cannot have been ligated.

"If one considers the anatomic position of the inferior laryngeal nerve and its topographical relation to the inferior thyroid artery, one sees that the trunk of the recurrent nerve, where it runs near the artery, lies so far inwards that it is not difficult to avoid it if one isolates the artery before tying.

"Based on the experience with the seven earlier cases of extirpation of goitre, Professor Billroth always makes it his particular aim to isolate the inferior thyroid before ligating it.

"It is remarkable that in spite of this precaution paralysis of the vocal cords occurred so frequently in our cases. Following the trunk of the recurrent nerve further upwards, one soon sees that it always rides over one of the branches of the inferior thyroid artery, and that, therefore, it is at this spot that there is danger of including it if the peripheral ligature is applied very near to the goitre.

"Therefore, no certain disproof can be offered that, in the three above-cited cases of complete one-sided paralysis, the recurrent nerve was not caught by the artery clamps.

"The cases of incomplete one-sided paralysis of the recurrent nerve (paralysis of the vocal cord only) cannot, therefore, be explained by the cutting of the trunk of the recurrent nerve.

"Following the recurrent nerve beyond its crossing of the branch of the inferior thyroid artery, it is seen that, gradually dividing into its filaments, the nerve runs along the posterior surface of the thyroid gland to the thyroid cartilage. If adherent to the capsule of the goitre, some of the fibres of the nerve may easily be torn in peeling out the tumor—a condition which may be responsible for most of the paralyses of the vocal cord.

"Thus, only, can one understand that sometimes there is an incomplete and at other times a complete paralysis of the recurrent nerve.

"It follows, therefore, that double ligation of the trunk of the inferior thyroid artery should be made as far as possible from its division into branches, and that the greatest care should be taken in freeing the goitre from the larynx and trachea in order that the branches of the inferior laryngeal nerve at this point shall not be torn."

Total Extirpation of the Degenerated Thyroid Gland

"According to the cases collected by Bruberger (*l. c.*) there have been 17 total extirpations of the thyroid gland, with two deaths.

"Adding to these the cases of Rose and Küster, and Billroth's new series of 16 cases, we have a total of 26 total extirpations, with four deaths—a mortality of 15.5 per cent.

"The suggestion to remove the whole thyroid gland instead of extirpating the goitre may be applicable to those localities where goitre is endemic; but where it is only sporadic the simpler procedure of enucleation of the tumor may well suffice. Professor Billroth decides on total extirpation only when the isolation of the goitre presents great technical difficulties, especially in those cases in which the goitre is intimately blended with the thyroid tissue. This much we know, moreover, that the removal of the degenerated thyroid gland in man is well borne, indeed so well, that from its loss we are not warranted in coming to any certain conclusion in regard to the physiology of the normal thyroid gland.

"And now some remarks on the dressings of the wounds in the last eight cases:

"As Professor Billroth advised in the Med. Wochenschrift, 1879, No. 1, we have used since November, 1878, for covering wounds, gauze impregnated with paraffin and kolofonium (not carbolized) from the Schaffhausener Fabrik. Apropos of this it must be emphasized that the wounds in the last eight cases of goitre extirpation—mostly very extensive operations—healed as quickly and with as little reaction as the earlier ones dressed with Lister's carbolic-acid gauze dressing.

"We observed, however, that in some of these cases swelling subsequently appeared about the margin of the wound, or that, the scar breaking down

at one point, slight suppuration would occur, and cease only when several silk ligatures came to the surface. The general condition of the patients was not further affected, although their stay in the hospital was lengthened from one to two weeks. Whether the suppuration was due to the silk ligature or to the tying off in mass of tissues, which having become necrotic could not readily be encapsulated when lying immediately beneath the skin, I do not venture to decide. Foreign bodies, especially needles, produce abscesses when they happen to be just under the skin, whereas they may lie for months or years in the deeper layers without exciting reaction.

"Professor Billroth inclines toward the latter view; against the first hypothesis speaks the circumstance that we observed in a large number of general cases as well as in several cases of goitre-extirpation that the carbolized silk ligatures healed in the wound without reaction."

In a postscript Wölfler states that in the course of the preceding few weeks Billroth operated successfully upon four additional cases of goitre (20 in all); two of these were total extirpations of the gland. It is interesting to note that whereas in the previous cases Billroth had cut his silk ligatures short, he left them long and hanging out of the wound in the last four, because the healing had been delayed a week or two by the late discharge of the short ligatures.

Billroth's Clinic in Vienna. Reported by Anton Wölfler. *Die Kropfexstirpationen an Hofr. Billroth's Klinik von 1877 bis 1881.* Wien. med. Wochenschr., 1882, Bd. xxxii, p. 5.

"Five years have now elapsed since Professor Billroth as result of his experience with the antiseptic treatment of wounds took up again the operative treatment of goitre and developed it in typical manner."

We may conclude, therefore, that during his first 10 years in Vienna, from 1867 to 1877, he rarely operated upon the thyroid gland, fearing to repeat his disastrous experiences in Zürich, where eight of his 20 patients operated upon for goitre died. In his preantiseptic period (1860-76) he operated upon 36 cases (Zürich 20, Vienna 16) with 13 deaths (36.1 per cent mortality). In his antiseptic period (1877-81) four of 48 cases (carcinoma excluded) died (8.3 per cent). Excluding five tracheotomized cases of this latter group, of the remaining 43, only one died (2.3 per cent).

As to the kind of operation performed, there were two enucleations (one death), 24 single lobectomies (one death), 22 total extirpations (two deaths). The recurrent laryngeal nerve was uninjured in 31 cases, paralyzed on one side in 11 cases, on both sides in two cases. Death from tetany occurred in one of the cases of paralysis of both vocal cords. In the same year Riedel [296] reported paralysis of both laryngeal nerves from irrigation

of the wound with a 2 per cent solution of carbolic acid after total excision of the thyroid.* The patient died of pneumonia following thyroidectomy.

N. Weiss. *Zur Pathologie und pathologischen Anatomie der Tetanie.* Wien. med. Wochenschr., 1883, Bd. xxxiii, p. 683.

Weiss reported on 13 cases of tetany which he had collected—Billroth (Vienna), eight cases; Albert (Vienna), two cases; Schönborn (Königsberg), two cases; Nicoladoni (Innsbruck), one case. The tetany had been observed only in young females and only after total extirpation of the gland. In three instances it had appeared within 24 hours of the operation, but usually not until several days thereafter—once as late as the tenth day. Having in mind a nervous origin (spinal cord) for the disease he emphasizes the fact that paralysis of the recurrent nerve occurred only in eight. Five patients recovered from the tetany, two died, and in one case the tetany still persisted (three years).

He discusses the question as to whether the operation was responsible for the tetany and decides in the affirmative. From his clinical and anatomico-pathological studies he is confident that tetany is due to a persistent condition of irritation in the anterior horns of the gray substance of the spinal cord. He believes that neither the operative insult, as such, nor the paralysis of the recurrent nerve, nor the elimination of any special function of the thyroid gland could cause this state of irritability of the spinal cord; he considers it far more possible, but not probable, that the ligation of the inferior thyroid arteries, by increasing the flow through the vertebrals may have caused hyperaemia of the medulla oblongata and spinal cord and thus have brought about the disease; but he believes it highly probable that the ligation of so many blood vessels in the course of the goitre operation sets up an irritation of the peripheral sympathetic nerves, and thus, an excitation of the vascular centres of the cervical spinal cord and medulla, which in turn brings about changes observed by him in the gray substance; namely, in the anterior horns of the spinal cord.

In three cases he found such definite changes in the ganglion cells of the anterior horns, particularly in the neighborhood of the fifth and sixth cervical roots, as to confirm his previous postulate that the cause of tetany is to be found in an irritable state of the ganglion cells of the spinal cord. He considered it, therefore, unnecessary longer to speak of tetany as a neurosis, but was inclined to classify it with the diseases of the gray substance of the spinal cord.

* Recently in the surgical clinic of The Johns Hopkins Hospital the musculo-spiral nerve was paralyzed in a wound freely swabbed out with pure carbolic acid. The wound was thus vigorously sterilized in order to prevent infection of the blood-clot with which an involucral cavity was to be filled. In about three weeks the function of the nerve was completely restored.

I have cited Weiss's views as to the cause of tetany chiefly as an introduction to the following remarks of Billroth, who took part in the discussion:

"There can be no doubt that tetanus and tetany are two perfectly distinct processes which have in common only the muscle cramps and the fact that they appear after operation. Tetanus, by the way, is beginning to become merely a matter of history. In the past 30 years I have seen only five or six cases, except in war-lazarets; and in Vienna only two cases in 16 years, and not one in the past 10 years.

"In most cases of tetanus there is trismus, which is not true of tetany; and tetanus follows wounds of the extremities. Tetany, on the other hand, seems to be due to conditions of irritation which proceed from the trunk and head. Tetanus and trismus are very dangerous; three-quarters of all cases die. From tetany most patients recover; it can, therefore, not be considered a milder form of tetanus. The unquestionable relation of tetany to goitre-extirpation naturally leads one to blame disturbances of circulation; but I doubt if this view is correct, for the following reasons: If we ligate both inferior thyroid arteries, an increase in pressure in the region of the subclavian can only occur when at the same time the routes for the returning blood have undergone a considerable change disadvantageous to the free circulation of the blood. But from the operation for goitre the alteration in conditions is favorable to freedom of the blood stream. The internal jugular vein is not ligated, but, on the contrary, is freed from the pressure of the goitre mass. Moreover, in the neck collateral routes are so numerous that it is doubtful if an increase in the blood pressure could occur. If this were not so, one should expect something similar to be observed after ligation of the carotid, which, however, is not the case.

"The partial extirpation of the goitre, as hinted at by the speaker (Dr. Weiss), would be more dangerous than the total unless it were indicated by a preformed goitre; the essential progress rests, indeed, upon this, that we take away the entire tumor—that we tie first the superior and then the inferior thyroid artery in order to be able to work on unembarrassed. Were we compelled to cut through the middle of the goitre, we should be confronted with a quite uncontrollable haemorrhage.* It is possible that the division in great quantity of nerves and the ligation of many arteries play a rôle. But we often perform operations for the extirpation of neoplasms, which are just as formidable as the goitre excisions, and there ensues no tetany; I am inclined, therefore, to lay especial stress upon the division of the numerous nerves of the thyroid gland, and believe that tetany occurs only in those individuals who are predisposed to nervous affections. The number of deaths in consequence of tetany is, altogether, not very great.

"Concerning the anatomical findings, they seem to point to the conduction from the field of operation of a nutritional disturbance; the proximity of the brain and spinal cord may have considerable significance;

*Billroth's view of the matter emphasizes the credit due to Mikulicz for the discovery three years later that, with proper preliminary precautions for the control of haemorrhage, there need be no bleeding on resecting a goitrous lobe.

these lesions (those described by Dr. Weiss) may perhaps occur in every case, but they must be present to a considerable extent in order to produce the picture of tetany. As to the changes in the vicinity of the nerves, I would not attach great importance to them; infiltrations in the nerve-sheaths occur more or less with every injury. The essential thing seems to be a disturbance of nutrition which extends along the axis cylinders; if such nutritional disturbances from wounds are to be regarded as inflammation, then we must call this process inflammatory."

O. KAPPELER. *Geschwülste des Halses. Chir. Beobachtungen aus dem Thurgauischen Kantonsspital Münsterlingen, 1865-70.* Frauenfeld, 1874, p. 99.

In the three years immediately following Billroth's term of service in Zürich, Kappeler enucleated encapsulated tumors in four cases and performed a lobectomy in one. All of the patients recovered.

He refers to the good service which a "Kreuzpincette" carrying a loop of thread might render, in the troublesome work of dealing with short vessels. So helpless were surgeons when confronted with blood vessels in the days before the introduction of the modern artery clamps.

A. LÜCKE. *Ueber die operative Behandlung des Kropfes.* Sammlung klin. Vorträge, Volkmann, Leipzig, 1870, No. 7 (Chirurgie, No. 3), p. 37.

Destined to play an important rôle in the drama of thyroid surgery was Lücke, eminent predecessor of Kocher in Bern; still in his prime, he died at the time when his record for goitre operations was the best in the world. Lücke's successful labors in this field could hardly have failed to stimulate Kocher, who was little more than a boy when he assumed the responsibilities of the directorship of the surgical clinic of the university. We are indebted to his assistant Brière [55] for the publication of Lücke's results, as we are to Süskind for knowledge of the work of his venerated chief, Victor von Bruns, and to Wölfler for the valuable and scholarly exposition of the contributions of Billroth, the adored master, to the solution of this complex problem.

Lücke advocated parenchymatous injections with tincture of iodine, and warns against excision because of the danger of haemorrhage and infection; he stated that the ligation of the thyroid vessels as recommended by Philipp von Walther [349] had been condemned.

In 1873 Lücke published a *Bericht über die chirurgische Universitätsklinik in Bern von Ostern 1865 bis Ostern 1872,* D. Zeits. f. Chir., Leipzig, 1873, Bd. ii, p. 337, but concerning goitres there is only the following paragraph:

"Among the solid goitres there was one large calcareous goitre, and one vascular goitre; the remainder were in part treated according to my method

with parenchymatous injections of iodine, and in part shelled out. Of 10 extirpations there was only one fatality. On the extirpation of goitre there has appeared a dissertation by my student, Dr. Brière von Yverdon."

Brière in his inaugural dissertation on the surgical treatment of goitre records nine cases operated upon by Lücke in Bern—two in 1865, two in 1868, four in 1869, one in 1870. Lücke in his report of his clinic up to Easter, 1872, speaks of 10 extirpations, hence he operated upon one case only from 1870 to Easter, 1872. The nine cases selected by Lücke for operation and reported by Brière were, as I interpret the records, all circumscribed tumors, quite undoubtedly adenomata. Local infection with infiltration of the tissues of the neck so extreme as to completely obstruct the trachea was the cause of death in the single fatal case. Brière reports also three operations by Professor Emmert of Bern, one of which resulted in death, and tabulates 73 operations from the year 1785 to 1871, as follows:

	Nombre d'opérations	Guérisons	Morts
"Cas opérés (1785-1845)*	29	18	11
v. Walther †	2	2	—
v. Bruns ‡	5	3	2
Emmert §	3	2	1
Billroth ‖	20	12	8
Middeldorpf ¶	1	1	—
Schuh **	4	4	—
Lücke ††	9	8	1
	—	—	—
Total	73	50	23"

"That Billroth's results were relatively so unfavorable is comprehensible if one bears in mind the fact that many of his patients were operated upon in extremis.

"The success of Lücke, on the other hand, is due not only to the skill of the surgeon and the prudence of the operative procedure, but also to the judgment exercised in discerning the indications favorable to operation."

Paul Sick. *Ueber die totale Exstirpation einer kropfig entarteten Schilddrüse und über die Rückwirkung dieser Operation auf die Circulationsver-*

"* Schmidt's Jahrbücher.

"† Zartmann, De Strumae Extirpatione, Bonnae, 1829.

"‡ Klein, Ein Beitrag zur chirurgischen Behandlung der Strumen, Tübingen, 1860.

"§ Brière, *l. c.*

"‖ Chirurgische Klinik, Zürich, 1860-67. Berlin, 1869.

"¶ Lebert, Die Krankheiten der Schilddrüse, und ihre Behandlung. Breslau, 1862.

"** Ausrottung eines Cancer fasciculatus der Schilddrüse und zweimal einer Struma glandulosa mittelst Galvanokaustik. Wien. med. Wochenschr., 1859, Jahr. 9, p. 641.

"†† Volkmann's Sammlung klinischer Vorträge, Nr. 7 (Chirurgie, Nr. 3), 1870."

hältnisse im Kopfe. Med. Corresp.-Blatt des Württembergischen Arztlichen Vereins, Stuttgart, 1867, Bd. xxxvii, p. 199.

The following case of Sick's deserves special emphasis, because for the first time symptoms of thyroid deprivation were observed to follow the operation—a total removal, possibly the first, of the thyroid gland:

Boy, aet. 10. Tumor, size of apple, tense, elastic, in the midline and to the right of it. Extended from the sternal notch to the lower border of the thyroid cartilage and, "remarkable to relate, on deep inspiration disappeared completely behind the breastbone." It caused great difficulty in breathing. The tumor was first noticed in the spring of 1866, about one year before Dr. Sick was consulted. September 18, 1866: Exploratory puncture. Only blood, a few drops, came through the cannula. Operation immediately thereafter.

Chloroform. Superficial veins divided between two ligatures, carried under the vessels with an aneurism-needle (procedure attributed by Klein and Sick to von Bruns). All the vessels were secured in this fashion as they were encountered. Division of sternohyoid and sternothyroid muscles. Tumor completely freed, except for firm adhesions to the trachea. It was then found to be continuous with the left lobe, which, however, was not much enlarged, although on palpation it was hard in spots and partly embraced the trachea. The propriety of dividing the isthmus was debated, but it was finally decided to remove the left lobe. The vessels of the upper pole (unnamed) were divided as on the opposite side, but the central ligature slipped and the wound immediately filled with blood. Many futile attempts to catch the bleeding vessels were made. The spurting artery threw such a powerful jet that the operator's eye became blinded several times with the blood and it was thought that the carotid must have been divided. The operator recalled a precisely similar case in the Tübingen clinic in which the carotid had been ligated to control the bleeding and in which later a secondary haemorrhage had occurred. Pressure on the carotid was finally made and the spurting vesel secured with an artery forceps.*

The left lobe was finally freed and the entire gland clung only to the trachea over an area the size of a "bean." The patient suffered so greatly from cramp of the glottis on attempts to ligate the pedicle that the advisability of tracheotomy was considered. Finally, by tightening the ligature very gradually the cramp of the glottis was not reproduced and the gland could be cut away.

This may have been the first case of total excision of the thyroid gland. Bruberger (*l. c.*), however, tabulates it as a partial extirpation and 17 others as total. In my opinion these figures should be reversed, for the

* Klein[188] and others report similar experiences with less happy result. This is a happening which even today occurs, particularly in the practice of surgeons who still employ catgut for ligation. A few years ago, in the course of a week's visit to a clinic where many goitre operations were performed and catgut was exclusively employed, this accident occurred twice under my eyes and once on the patient's transit to the ward.

only extirpation which without question could have been total was Sick's. This matter I have discussed in connection with Bruberger's paper.

High fever. Pulse at one time 150, but in about 12 days the patient's condition was quite normal. In two months after the operation the patient was discharged with a small granulating wound.

The specimen removed—about five times the size of a normal gland—showed disseminated colloidal changes. November 4th: Letter from patient describes nasal haemorrhages. December 12th: Letter. Nasal bleedings have ceased, but there is a running from the nose which is so profuse that the upper lip has become raw. June 1, 1867: Boy has returned for examination. He seems in blooming health, but the father states that his psychical behavior is entirely changed. Formerly joyous and lively, he is now silent, quiet and dull.

Sick's is perhaps the most complete total extirpation, up to that time, of the thyroid gland; it supplies also, as I have said, the first report of the condition which we now recognize as status thyreoprivus. Previous cases had, with few exceptions, been excisions of circumscribed tumors, cystic or solid, or of more or less readily enucleable portions of colloid goitre. Thus, in the first case of total excision psychic symptoms were produced. Two explanations suggested themselves to the operator: (1) Disturbed circulation in the brain due to removal of the organ (thyroid gland) which was supposed to regulate it; (2) the thyroid might be the place where certain "Umsetzungen" of the blood constituents take place and with its removal the chemically altered condition of the blood might lead to qualitatively changed nutrition of the brain. The Medical Verein of Stuttgart (June 6, 1867), after due consideration, concluded that the second of these hypotheses had most to commend it.

Theodor Kocher. *Zur Pathologie und Therapie des Kropfes.* D. Zeitschr. f. Chir., Leipzig, 1874, Bd. iv, p. 417.

Hardly a year has passed since Kocher was called to the chair of surgery at the University of Bern in which one or more papers on goitre have not appeared from his pen.

Among Kocher's significant contributions to the subject are: (1) Discovery of the fact that total extirpation of the thyroid gland is followed by body changes, to which he gave the name cachexia thyreo- or strumipriva; (2) the studies with his life-long friend Langhans of malignant tumors of the thyroid gland; (3) the perfecting of the operation of thyroidectomy; (4) the stimulus which he gave to the operative treatment of Graves' disease and to the study of the milder forms of hyperthyroidism; (5) the recognition of engrafted forms of Graves' disease; (6) the demonstration of the value of the ligature of the arteries as a preliminary step to lobectomy, in

the highly toxic cases; and (7) the danger of the indiscriminate administration of iodine to patients with goitre.

In 1872, Theodor Kocher, at the youthful age of 31,* succeeded Lücke as director of the surgical clinic in Bern, his native town. Stimulated, presumably, as I have said, by Lücke's success in the operative treatment of goitre and by the great number of patients suffering from this disease who must have applied for relief at the surgical clinic of Bern, Kocher in the first two years of his incumbency, was able to credit himself with 13 extirpation operations upon the thyroid gland. Among these were two total excisions and two évidement † or "Ausschälung" operations; the remainder were, seemingly, enucleations of circumscribed tumors. Two of his patients died—the first and the last, and from infection. In both of the cases of total excision recovery took place. Billroth, at this time, had, apparently, discontinued operating for goitre, being convinced that the danger, chiefly from sepsis, was too great. He had performed only one total excision; this patient died within 48 hours, probably from haemorrhage—plus, perhaps, infection. Kocher writes:

"The chief danger in extirpation is the profuse bleeding ‡ which occurs from the numerous arteries, but much more from the enormously developed venous plexus about the glandula thyroidea. To attempt to lessen the haemorrhage by ligating the four arteriae thyroideae, as has been proposed of late, seems theoretically very rational, *but such a procedure is almost identical with extirpation of the goitre itself.*" §

In six cases the indication for operation was dyspnoea. In five of these the tumor was of the "goître plongeant" variety. The incision employed was either along the edge of the sternomastoid muscle (for laterally situated tumors) or in the midline.

"It is absolutely essential for the most successful carrying out of the operation that the operator should not permit himself to be frightened off by any difficulty from dissecting down to the goitre tissue proper; he must not leave the thinnest connective tissue capsule undivided. *It would be better to cut into the goitre itself, to make sure, rather than in the deliverance of the tumor behind, to find oneself floundering in the lateral tissues of the neck.*" §

It is interesting, further, to note Kocher's method, at that period, of managing the blood vessels of the pedicle.

* Billroth was in his 39th year when he was called to Vienna.

† The exposed tumor having been split in two was shelled out with the finger or sharp spoon from within the capsule which was then sewed to the incised edges of the skin. Lücke terms the method an "intracapsuläre Ausschälung."

‡ Kocher had lost no case from haemorrhage.

§ Italics mine (W. S. H.).

"At the posterior periphery of the tumor there occur regularly, even when the operation has been properly conducted, strong, pedicle-like binding strands which often contain huge blood vessels. One reaches most quickly the goal by piercing and surrounding these bands with the artery-hook * and, according to their thickness, by dividing them into two, three or even into six parts and tying forcefully. There occur cases in which the final portion, often over a considerable area, is bound to the trachea by unstretchable adhesions. Under such conditions, *ligation in parts being impossible,*† one must have recourse to the ligature *in toto* and cut off the tumor with the knife, leaving a stump behind."

A few years later Kocher accomplished this step in the operation, in the manner which in 1874 he had considered impossible.

Particularly worthy of note is the observation of Kocher in the case of Marie Richsel, aet. 11 years, whose thyroid gland he had completely removed.

"According to the report of the physician she enjoyed unclouded health during the first two weeks after her return home, but latterly a remarkable change in the behavior of the child has taken place. She has become peevish and dull, and will not work except under compulsion, whereas formerly she was a spirited and joyous creature.

"*We shall learn from the further progress of the case whether there is any relation between the extirpatio strumae and the altered mental condition.*" ‡

This observation of Kocher's (January, 1874)§ was made only a few months after Gull's (October, 1873)[142] description of a peculiar idiopathic condition in adults, to which two years later Ord[266] gave the name myxoedema, and many years prior to Murray's discovery (1892)[250] that operative myxoedema can be dissipated by the administration, subcutaneously, of thyroid extract.

Fagge in his paper (1871)[112] on sporadic cretinism occurring in England reported a case which began as late as the eighth year, but it had not occurred to him or to Gull that lack of thyroid gland might be responsible for the condition.

Greater advance was made in the operative treatment of goitre in the decade from 1873 to 1883 than in all the foregone years—I may say, than in all the years that have followed. Unquestionably this rapid progress

* Aneurism-needle is probably meant, although "Arterienhaken" signified tenaculum also.

† Italics mine (W. S. H.).

‡ Italics mine (W. S. H.).

§ Sick, in 1867,[320] was, perhaps, the first to note these sequelae of the operation. He was first also to perform successfully what was, except for a possible remnant on the trachea, a total lobectomy. In Patrick Watson's excisions of the entire gland it is probable that at the pedicle of each lobe a considerable stump of gland tissue remained.

was due chiefly to the possibilities and the impetus given by the introduction of antiseptic surgery. Germany, Austria and Switzerland were the countries whose surgeons accepted promptly the doctrines of Lister. It was the German surgeons, notably von Bruns, Bergmann, Schede, Kümmel, Neuber and Schimmelbusch, who did most to eliminate the unessential features of Listerism and to replace antisepsis with asepsis.

In 1883 Kocher [192] published a famous paper in which he considered the evil consequences of total strumectomy and standardized, may I say, the operation of thyroid lobectomy.

In the 10 eventful years above mentioned he had performed 101 operations upon the thyroid gland, a greater number than any one except Billroth, and in the 17 months preceding the publication of this paper he had operated upon 39 cases of nonmalignant goitre with two deaths, the two fatalities occurring in quite hopeless cases operated upon in emergency. In the same period he had excised the thyroid gland four times for cancer, with only one death.

Kocher writes:

"Up to the present time (1883) I have performed 101 goitre-extirpations.* Thirteen of these patients died, a mortality of 12.8 per cent. A year ago there appeared in the Correspondenz-Blatt für schweizer Aerzte a publication on the indications and results of goitre-extirpations in which I endeavored to complete and then extended the statistics which, under the guidance of Bruns, Süskind had collated. Whereas before 1850 about 70 goitre extirpations are known to have been performed, the number in 1877 had risen to 146.†

"Whereas, according to Süskind and Wölfler, the mortality up to 1850 amounted to 41 per cent, it had decreased to 21.2 per cent for the 146 cases operated upon between 1850 and 1877."

In a characteristically thorough and painstaking manner, by correspondence as well as from the literature, Kocher was able to gather reports of 240 cases of nonmalignant goitre operated upon since 1877. In this series there were 28 deaths, a mortality of only 11.6 per cent. In the same period (1877 to 1883) he collected 28 cases of operation for malignant struma, with 16 deaths, a mortality of 51.1 per cent. Appended to his paper are abstracts of 236 of the above-mentioned cases.

Kocher in this series *had no deaths from sepsis,* which had been responsible for all the fatal results save one (Billroth's case, No. 17) in the cases

* Kocher announces that he will hereafter employ the word "Strumectomie" instead of the ambiguous and troublesome name "Thyroidectomie."

† To Süskind's collection Kocher had added three cases of his own, two of Kappeler, five of Rose, two of Czerny (communicated by letter) and the 16 cases of Billroth reported by Wölfler to which I have made reference above.

theretofore reported of von Bruns, Billroth, Lücke and Kocher, nor had he at any time lost a patient from haemorrhage, although he had stated in his first paper (1873) that "the chief danger in extirpation is the profuse bleeding." Thus, even in the days before artery clamps were generally in vogue, when the art of controlling haemorrhage was relatively crude, there were no deaths from loss of blood at the hands of these competent surgeons. Nevertheless, the operation of strumectomy still made great demands upon the fortitude and skill of the surgeon.

Kocher had made a careful study of the blood vessels of the thyroid gland, particularly of the veins, and as result of this evolved, as had Billroth independently, a method which is essentially the one he practises today. He writes:

"In the first place it must be emphasized that one must not permit oneself to be led astray by Virchow's pronouncement that the irregularities of the blood vessels, 'kaum bei einem anderen Organ grösser sein können.' In most cases the vessels conform in their arrangement to a perfectly definite plan."

Excellent lithographs illustrate the result of his studies of the circulation of the gland. He credits Watson (*l. c.*) and Michel (*l. c.*) with having advised, both of them in 1873, ligation of the thyroid arteries as a step in the operation preliminary to the extirpation, but condemns their method of ligating *en masse,* on account of the intimate relation of the recurrent nerve to the inferior thyroid artery.

"Furthermore," writes Kocher, "the bloodless exposure of the inferior arteries is made possible only by the previous double ligation and division of a number of veins. . . . . What makes the securing of the veins in goitre operations especially necessary is the avoidance of injury to the recurrent laryngeal nerve. Wölfler was the first, in thorough manner, to call attention to this danger and to make clear the reasons for it. I must agree with him and Billroth that it is comparatively easy to spare this nerve when ligating the inferior thyroid artery. The artery must be isolated with precision before the ligature is applied, and the trunk of the artery must not be ligated near its point of entrance into the goitre, but laterally, at some distance from it."

Kocher's operation in 1883: To a vertical incision of skin from manubrium to cricoid cartilage was added an oblique incision outwards and upwards from the cricoid cartilage to the anterior border of the sternomastoid muscle (Kocher's Winkelschnitt). The chief object of this incision was to give the operator free access to the lower pole "where the largest veins develop," and to the trachea in the region of the gland's attachment. The oblique portion of the incision, which divided the platysma as well as the skin, crossed the subcutaneous veins and thus made possible, at the

outset, the double ligation of the anterior and oblique jugular veins and, if necessary, of the external jugular also. The sternohyoid, sternothyroid and omohyoid muscles were then divided in line with the oblique cut of the skin.

"Contrary to Billroth and to our own earlier method, we no longer split the capsule of the goitre at this stage of the operation. Our further procedure is determined by the intention to isolate and ligate each of the larger arteries and veins before dividing it and especially by the desire to have completely freed the tumor before undertaking to separate its pedicle from the trachea.

"At the outset we proceed to ligate the superior artery and vein. By following the vessels on the anterior surface and mesial edge of the tumor to the extreme tip of the upper pole, one easily and surely is guided to the main trunks which form the stem-like continuation upwards and outwards of the upper pole. These vessels are then ligated and divided, having been isolated with the aid of a specially designed 'Kropfsonde,' provided with three grooves. Proceeding from the upper pole downwards along the outer edge one encounters the transverse vena thyroidea superior accessoria, in case it is present, and divides it after double ligation. Then, tracing along the mesial edge of the upper horn, one treats in the same manner the vena thyroidea communicans superior, which courses over the trachea along the upper edge of the isthmus. Thus the upper pole is free, and now one turns to the lower pole. If feasible, the finger is made to encircle the lower pole which is then drawn upwards. In the case of strongly compressing strumas causing considerable dyspnoea it is often necessary for the sake of better narcosis to deliver the struma promptly, especially in cases of struma descendens.

"From the inner edge downwards there stretches the vena thyroidea ima, often a very large vessel, which must be ligated and divided. Outwards and downwards from the lower pole stretches the ordinarily smaller, but occasionally equally large, vena thyroidea inferior, and further to the side and upwards the transverse vena thyroidea inferior accessoria. Both of these must be doubly ligated. At the lower edge of the isthmus when there is a double vena thyroidea ima one may find a vein connecting the two; this may be called the vena thyroidea communicans inferior. Except for a few small irregular little veins, the tumor, at this stage, is held only by its pedicle; namely, by the isthmus which binds it to the upper rings of the trachea. The goitre is then rolled inwards and taken into the hand, and now the moment has arrived when one must keep close to the surface of the gland. The capsule (*the external capsule—not the capsula propria, which must remain intact*)* being split and the tumor thus further released, the trunk of the inferior thyroid artery must be isolated and tied far away from the tumor, as near as possible to the carotid. The isolation must be done with the greatest care, and one must assure oneself that the recurrent nerve is not being caught in the ligature. Keeping close to the gland, one works without haste along its posterior surface towards the trachea, and, relying on pressure to occlude the peripheral lumina, catches each spurting

* Italics mine (W. S. H.).

vessel as finely as possible. The isthmus being reached, it is gradually divided as, one after the other, each vessel is secured.

"By following this method the recurrent nerve can often be beautifully dissected out; but injury to it can with certainty be avoided without this direct exposure. Since we have adhered strictly to this procedure, the hoarseness, formerly so frequently observed after operation, has now become exceptional."

I have quoted from Kocher's description of his operation at such length that the reader, contrasting his method of 1874 with that of 1883, might note the progress made by him in nine years.

Whereas, formerly, he had urged the operator not to be frightened off by any difficulty from dissecting down to the goitre tissue proper, and hence to extirpate it from within its intrinsic capsule, he now dissects along the plane external to the external capsule (two planes removed), and only after he has ligated both thyroid arteries and delivered the tumor does he split the external capsule. He now accomplishes with ease the clean dissection of the "pedicle" (isthmus) from the trachea, tying each vessel as it spurts, an act which, in 1874, he thought insuperably difficult. Paralysis of the recurrent nerve, which very often was then observed, is now an accident of rare occurrence. The larger blood vessels are being isolated before tying, and ligation *en masse* of the pedicle, *in toto* or in parts, is in disfavor.

The value of the artery clamps is not likely to be overestimated. They determine methods and effect results impossible without them. They tranquilize the operator. In a wound that is perfectly dry, and in tissues never permitted to become even stained by blood, the operator, unperturbed, may work for hours without fatigue. The confidence gradually acquired from masterfulness in controlling haemorrhage gives to the surgeon the calm which is so essential for clear thinking and orderly procedure at the operating table.

In this classic paper Kocher makes a contribution to physiology even greater than to surgery. Eighteen patients of 34 with total excision returned for examination. Of these only two were free from the symptoms which we now know to be due to loss of the thyroid gland. He describes at length and discusses quite exhaustively the possible causes of the mental and other physical changes characteristic of hypothyroidism, notes the striking resemblance to cretinism, and for the syndrome proposes the name cachexia strumipriva:

"We prefer for the present to employ for the designation of this group of symptoms an altogether non-committing name (einen ganz unverfänglichen Namen). To designate the nutritional disturbances which accompany the disappearance of goitres after the administration of iodine the

name goitre cachexia (Virchow) has been used, but with the addition of the adjective iodica; we see no objection to the employment for the time being of the name cachexia strumipriva."

And here, in a footnote, he makes the comment:

"It is to be emphasized that the picture of cachexia with rapid emaciation, increase in the pulse rate, etc., which has been observed after the disappearance of a goitre in consequence of and also without (von Roser) the employment of iodine bears no resemblance to the condition described by us."

Thus early is foreshadowed his work 35 years later on *Iod-Basedow*.[199]

In each of the two cases of total excision in which strumiprivic symptoms were not manifested it was observed that a nodule, presumably consisting of thyroid tissue, made its appearance after a time.

Many pages are devoted in this paper to the consideration of the possible cause or causes of the progressive anaemia which was observed in the thyroidectomized patients:

"The question arises: would a faulty development or atrophy and softening of the trachea explain the high degree of progressive anaemia which occurred in these individuals? We believe so. The affirmative answer to this question would at the same time explain the anaemia observed in general in cases of goitre, which most authors are inclined to regard as the cause of the goitre, but which in reality is the consequence."

It is interesting to follow the argumentation of a mind so exceptionally keen and sane as Kocher's in its futile efforts to explain insufficiently illuminated phenomena. For example: He had made, six years before, an excision, almost total, of the thyroid gland in a boy aged 17. For five years the boy enjoyed perfect health, then on recurrence of the goitre on one side, cretinoid symptoms appeared.

"*The change in the condition of the patient cannot be explained by the elimination of the function of the thyroid.** But there was opportunity for especially unfavorable action upon the trachea by the recurrent goitre."

Today we know that the symptoms were due to the further degeneration of the remaining portion of the thyroid. It had not occurred to him that increase in the size of the gland might signify diminished function. Once this interpretation could be conceded, the true relationship of the cretinoid condition to the colloidal hypertrophy of the thyroid would easily follow. And, conversely, even many years later the vascular and hyperplastic gland of exophthalmic goitre could not be accepted as the cause of the symptoms of Graves' disease.

* Italics mine (W. S. H.).

And again: "As I have said, the thyroid gland is regarded by Liebermeister and Schiff as a regulator of the circulation of the brain. Guyon, Ricou, and Maiqueux have further elaborated this conception. According to Maiqueux (*vid.* Hermann, *Physiologie,* p. 464) the carotid becomes pulseless after prolonged holding of the breath and after violent muscular exertion. The thyroid gland, accordingly, serves as a safety valve against overfilling of the brain with blood, for the blood, instead of having only the internal jugular vein in which to be blocked, may fill also the thyroid veins; then by means of the thereby greatly swollen gland whose sheath is bound up with the fascia of the vessels of the neck, and by the simultaneous contraction of the pretracheal muscles, the carotid becomes compressed. According to numerous, not yet published, measurements of my former assistant, Dr. Meuli, the circumference of the head and of the neck is greatly increased in the reversed position of the body; this increase is observed to be most marked and to occur soonest in the neighborhood of the thyroid gland.

"It is quite conceivable that after removal of the thyroid gland more frequent disturbances of the circulation occur in the region of the head, and that it is these disturbances which have in train the bloated face as well as altered function of the brain and sluggishness of thought and speech; for, as explained, we cannot, without further evidence, attribute these symptoms to anemia alone.

"*We believe, therefore, that the symptoms which condition the picture of idiocy are probably determined by the disturbances of the cerebral circulation, while the cachexia is to be explained by the influence upon the breathing, upon the supply of oxygen, in so far, at least, as it may not be ascribed to the cutting out of that function of the thyroid gland which serves in the formation of the blood.**

"If the explanation of the fact observed by us that cretinoid changes follow excision of struma is correct, namely, that the alteration of the general condition is brought about by secondary changes, then we have advanced a point also in the interpretation of the association of goitre and cretinism in the same individual, one with goitrous parents.

"The occurrence of cretinism in consequence of goitre can, on the basis of the fact of its appearing after removal of the thyroid gland, be interpreted thus: We may suppose that in cretins nothing remains of the normal gland, that everything is pathologically altered and therefore this particular function of the gland is lost. Further investigation must devote especial attention to this matter and also to the relative size of the trachea in cretins."

It is remarkable, as I have said, that symptoms of tetany—and these were transitory—were observed in only one of the 18 cases of total extirpation of the thyroid which returned to Professor Kocher for examination. This is in striking contrast to the relatively frequent occurrence of tetany in the cases operated upon by Billroth about the same period. The tetany was regarded by Kocher as an indication of particularly intense cerebral disturbance.

* Italics mine (W. S. H.).

THEODOR KOCHER. *Bericht über weitere 250 Kropfexstirpationen.* Correspondenz-Blatt für schweizer Aerzte, Basel, 1889, Bd. xix, p. 1.

"Discussing in 1882 in this journal the question of the indications for extirpation of goitre on the basis of 58 operations, I found from a review of the statistics of the various operators that their mortality was 13.9 per cent; my own was approximately about as high—14.8 per cent. After careful determination of the cause of death in each case I felt justified in drawing the conclusion that this 13.9 per cent mortality was not the final verdict, that we might anticipate much greater success; indeed, I ventured to formulate the sentence, 'The timely excision of an ordinary goitre is an operation free from danger.' Justification for the expression of this favorable view was derived from the fact that the majority of the fatalities were attributable directly or indirectly to imperfect asepsis of the wound, and from the likelihood that with a perfect antiseptic technique the still existent chief danger would be eliminated. Then, in April, 1884, at the Twelfth Congress of the Deutsche Gesellschaft für Chirurgie in Berlin where I called attention to the cachexia strumipriva which follows goitre-extirpation, a danger referred to in single instances, but not as yet appreciated, I could add to my 58 excisions 43 others in which the mortality had fallen to 6.9 per cent, or, excluding the malignant strumas, to 5.1 per cent. Since then at the Bernese clinic (and my private clinic) we have performed 250 additional operations, and one might well be allowed to review again the results of this 5½-year period of activity, in order, on the one hand, to formulate for the physician something tangible in regard to the indication for goitre-excision, and, on the other hand, to give to a colleague here and there a hint as to the method of procedure which after a little practice might be useful. . . . . We have lost six of the 250 cases operated upon since our last publication. This would give a mortality of 2.4 per cent in contrast to 6.9 per cent for the statistics reported in 1883, and to 14.8 per cent in 1882. But small as this mortality is, it falls considerably if one includes in the computation only the ordinary goitres. By ordinary goitres we do not mean the easy or simple forms, for we were called upon to perform the operation under the most difficult circumstances; frequently the goitre was inflamed at the time of operation; more frequently we had to deal with deeply situated strumas, some of them completely buried within the thorax; and usually there was extreme dyspnoea, due to stenosis of the trachea. Further, the operation was undertaken at times upon old individuals and upon badly nourished people. Under the term unusual goitres we include only the malignant ones and the gland of Basedow's disease.

". . . . Excluding the malignant strumas from our calculation there remains a mortality of only 1.3 per cent for the other forms of goitre. . . . . If further we subtract the five Basedow cases, the mortality for the remaining 225 becomes reduced to 0.8 per cent. . . . . One will therefore not consider it an exaggeration when we affirm that *the operation upon an ordinary goitre even under very difficult conditions, however large the growth and however old the patient, has been entirely robbed of its dangers,* that one has no longer need to speak of a mortality in consequence of the excision of a goitre."

In April, 1895, at the annual meeting in Berlin of the Deutsche Gesellschaft für Chirurgie, Kocher [194] announced that he had operated upon more than 1000 cases of goitre. Twelve years before, on the occasion of the presentation of his famous paper on *Cachexia thyreopriva,* he gave the results of operation in his first 100 cases. He had then established the fact that not one of his cases of total excision had escaped the cachexia. Since 1883, therefore, in only one instance had he removed the entire gland; in this exceptional case, and only in this one, the cachexia had developed. Tetany, regarded as the acute form of the cachexia, manifested itself transitorily in a number of instances, but only once (operation for carcinoma) in severe form. In the 900 cases operated upon in the 12 years the mortality was a little over 1 per cent, exclusive of the malignant and Basedow cases.

A new series of 600 operations was reported by Kocher in 1898.[196] In this series for the first time his assistants, Roux, Tavel, Lanz, de Quervain, Schwyzer, Fischer, Albert Kocher and others, were permitted to operate upon some (150) of the patients. For more than two years he had employed cocaine anaesthesia and states that the danger in complicated cases was greatly lessened thereby. Now, too, he recommends the collar incision:

"The first distinctive feature of our method consists in this, that we make, as a rule, a so-called collar incision, namely, a transverse bow-shaped cut with its convexity below, which leaves a much more beautiful scar than any other. This we have demonstrated sufficiently often before gatherings of physicians. Occasionally we make an angle cut (Winkelschnitt) which together with the collar incision we have described in detail in our book (*Operationslehre*).[195] . . . . Further, we do not, as we have so frequently seen, make a transverse division of the muscles; we go between them and free only above and partly the attachments of the muscles which stretch from the sternum to the larynx, of the sternohyoid and sternothyroid, in order to insure for them an intact nerve supply. . . . . As a third essential act of our method we regard the luxation of the goitre, a procedure already described by us. When the connective-tissue capsule has been split with precision down to the gland and, when necessary, the accessory veins described by us have been ligated, the circumference of the goitre is freed so that it can be rolled over to the tracheal side. This luxation being accomplished, the act of ligating the main vessels is made easier. This again we regard as one of the special features of our operation, that we make it a point to ligate these vessels before shelling out the goitre. . . . . This difficulty of determining beforehand the side on which to make the excision brings us to the question of total excision in the cases, for example, in which the surgeon ascertains too late that, having removed the larger lobe, it is the other lobe which is making the pressure on the trachea. It would seem useless to waste further words on this subject, after having in 1883 brought proof that each total excision in man leads to a greater or less danger of cachexia thyreopriva and since subsequent experiments and clinical observations have confirmed my statements. But we note from recent letters and

publications that this question still agitates certain minds. Thus Munk in Berlin insists that the consequences of total excision are attributable to accidental traumatisms in course of the operation. And Bottini in a work on the surgery of the neck declares that he has not seen harm result from total excision of the gland. It is superfluous for us to state that since the spring of 1883 we have made no total excision without compelling conditions. . . . . In this case both thyroid halves were removed because on both sides a high degree of pressure was exercised upon the trachea. In addition to circumstances such as this we find necessity for removing both halves when, in absence of a thin isthmus, the two lobes are welded together in a mass over the trachea. In such cases an attempt to divide the firm colloid masses may be accompanied with haemorrhage so severe that *ex indicatione vitali* one might better remove the whole tumor. With the exception of these two possibilities only the malignant nature of a struma can justify the total excision."

Kocher has not as yet learned how to deal with a thick isthmus.

I saw Kocher for the last time in the spring of 1914, when we spent four or five days together in Berlin attending the Congress of the Deutsche Gesellschaft für Chirurgie. At that time he was still performing in all except very exceptional cases a one-sided lobectomy. He never approved of the suggestion of Mikulicz to remove, as a regular procedure, the greater part of both lobes.*

Of the 600 new cases reported by Kocher in this paper of 1898, 556 were colloid strumas. Chloroform was the cause of the only fatality in this series. The patient had a greatly enlarged thymus gland. The mortality was only $\frac{1}{100}$ of 1 per cent.

At the 30th Congress der Deutschen Gesellschaft für Chirurgie, April, 1901, Kocher [197] reported a second thousand operations for goitre.

"We make, whenever possible, the excision of the half which exercises the greater pressure. It is not always quite easy to determine the side from which the chief pressure comes, and pressure upon the less culpable side often causes less dyspnoea than when made upon the other (for reasons which will be developed later). Especially often we find that the larger nodule is on the right side and that on the left is the one more deeply situated and more forcibly pressing.

"Enucleation, a much bloodier and less reliable procedure, we resort to only in the very rare cases of recurrence (4 in 1000) of the goitre, or when there is atrophy of the other lobe, as one observes especially in cretins, or finally when the capsule of the gland is densely adherent.

"We make, as a rule, the transverse, symmetrical bow-incision through skin, platysma and fascia, then the median cut between the muscles, which are divided only in the most difficult cases; we ligate, where possible, the

* In the cases of colloid goitres and in the milder forms of Graves' disease it is our practice to remove a part of each lobe, but not precisely in the manner practised by Mikulicz.

accessory veins which pass over the surface of the goitre and afterwards the two main bundles containing the superior and inferior thyroid vessels; we luxate the goitre out of its adventitia, divide the isthmus and free the lobe, leaving in suitable cases the posterior capsule of the gland. For dividing the isthmus we have advantageously employed a tissue-crushing forceps which works like the modern angiotriptor, but not with the idea of crushing particularly the vessels, but rather of crushing through the tissues so that only the vessels remain for the ligature *—briefly, to avoid the ligation *en masse* which unfavorably influences primary healing.

"The results are as follows: Of 27 malignant strumas six died; of 20 cases operated upon for strumitis two succumbed, and two also of the Basedow cases. Of 929 benign strumas four died—a mortality of 0.4 per cent. The cause of death in one case was chloroform narcosis and status thymicus. We were compelled to anaesthetize this child because he was unmanageable. One died of acute cachexia thyreopriva, one of poisoning by corrosive sublimate which, contrary to orders, had been used for disinfecting the skin, and, finally, one of pneumonia four weeks after an exothyreopexy. The operation in this last case was so bloody that it could not have been continued without immediate danger.

". . . . One may conclude, therefore, that in the excision of an ordinary goitre, however large and however great the difficulties, the danger of haemorrhage and of infection no longer plays a rôle. . . . . The danger in the operation for an intrathoracic struma is the haemorrhage. The patients suffer almost without exception from a high degree of constriction. When now one draws through the upper aperture of the thorax a struma immobilis whose diameter is greater than this space, the trachea becomes for the moment compressed, the dyspnoea increases to the suffocation point, each little vein that is torn begins to bleed, not to mention the greater venae thyroideae imae, and the situation is critical. It is of first importance that one doubly ligates the accessible vessels from above, the superior thyroid artery and vein and especially the veins named by us *accessory;* also, that one divides the isthmus and completely isolates the cervical part of the tumor before one proceeds to dislocate the deepest nodule. Then is one prepared to deliver the goitre; indeed, it is often a matter of a genuine delivery which can only be accomplished with an obstetrical forceps and spoon. We have had constructed for this purpose a special goitre forceps and a goitre spoon, in order to be able to extract the tumor from the depth safely and quickly.

". . . . Worst of all are the cases in which the tumor is absolutely too large to pass through the aperture of the thorax. Then nothing helps short of breaking up the tumor as if it were a myoma; but the morcellement must not be done in gynecological fashion; one must practise the évidement described by me, and bore rapidly into the tumor with the finger, breaking up the soft portions within the capsule, opening cysts (occasionally also an abscess) and draw out the tumor to the light of day. This method is truly decidedly more bloody and for its execution requires occasionally a tra-

* Mikulicz was the first to advocate this method and to discover that one might with impunity crush through the colloid masses.

cheotomy. For such an emergency cannulae are necessary, long enough to reach beyond the stenosis; they should be at hand in every case."

Within five years (from November, 1900, to August, 1905) Kocher[193] added another thousand (his third thousand) to his list of goitre-extirpations. Nine hundred and four operations were for the nonmalignant and non-Basedow forms, for the "ordinary" forms of goitre. Three patients of this colloid group died; one death was from secondary haemorrhage in a case of congenital cachexia thyreopriva; a second, from pneumonia, after the wound was healed, in a patient with dilated heart and atrophic kidneys; the third fatality occurred in a patient with a high grade of myocarditis, who from childhood had been afflicted with paralysis of both recurrent laryngeal nerves.

"This result may, in a measure, be taken as a criterion for the prognosis of major operations in general, because a goitre-extirpation in most cases is a serious affair which makes high demands on the surgical art.

". . . . The glory of this happy outcome of our therapeutic endeavors to relieve an affliction so sore falls to the three luminaries (Dreigestern) Pasteur, Koch and Lister, on whom therefore with full justification we have conferred honorary membership in this society.* In exemplification of this fact one may glean pronouncements particularly of French authors from the years 1875 and 1885; thus Luton,† the discoverer of iodine injections, writes: 'Il y a lieu de s'étonner qu'une opération aussi redoutable soit encore sérieusement conseillé de nos jours.'"

Once or twice or three or more times each year, up to the spring of 1914, Professor Kocher published the results of his studies of the thyroid gland and its diseases. At the time of his death, July 27, 1917, approximately 5000 cases of goitre had been operated upon in his famous clinic. For nearly half a century Professor Kocher had been in surgical harness at Bern, toiling vigorously and triumphantly to the end.

J. L. Reverdin. *Accidents consécutifs à l'ablation totale du goître.* Société médicale de Genève, Séance du 13 septembre, 1882. Rev. méd. de la Suisse romande, Genève, 1882, t. ii, p. 539.

"M. J. L. Reverdin thereupon made a communication in regard to the happenings consecutive to the total ablation of goitres. Up to the present time he has performed 14 operations and has had only three deaths: in one case, the cause of death was pneumonia; in another, complex nervous manifestations; and in the third, a cancerous goitre, death occurred from suffocation in the course of the operation. Mons. J. L. Reverdin has observed, in the recovered cases, sequelae hitherto undescribed, and to these he invites the attention of the society. Two or three months after the operation the patients have, for the most part, presented a state of feebleness, pallor,

* Die Deutsche Gesellschaft für Chirurgie.

† Duget. Goîtres et médication iodée interstitielle, Paris, 1886.

anaemia, accompanied in two of them with oedema of the face and hands, without albuminuria; in one, a contraction of the pupil, melancholy, heaviness; in another, the facies closely resembled that of the cretins. In the majority of the patients, this condition was a long time in disappearing, and in three of them it has continued already a year. Not one of the writers giving the subject consideration has called attention to these sequelae of ablation of the thyroid gland, hypertrophied or otherwise affected.

"Mons. Kocher has, however, related to Mons. Reverdin that in a case observed by him the patient remained depressed and feeble after his recovery. Mons. J. L. Reverdin has observed a case of tetany following operation, and Mons. A. Reverdin a second one, which has recovered.

"What part does the nervous system take in the production of these phenomena? Should the irritation or insult to the great sympathetic be taken into consideration? Or, indeed, the thyroid body, whose functions are still obscure to the physiologists, has it played in haemopoiesis a rôle so important that its ablation could entail so profound a trouble in the economy? In view of these results Mons. J. L. Reverdin has modified his method. Formerly he removed the thyroid body in its entirety, when this was possible. Today he respects the enveloping membrane, or conserves a portion of the gland. From the removal of only one lobe of the thyroid body he has not had a consecutive accident."

Hence Reverdin anticipated Kocher by about one year, and appellated the train of symptoms which followed his total excisions of the thyroid gland *myxédème opératoire.*

Thus the story is brought to 1883, to the time when the art of operating for goitre, particularly by Billroth and Kocher and men of their school, had been almost perfected, relatively minor problems remaining to be solved.

Functional derangements of the thyroid and parathyroid glands have been only cursorily referred to in this paper, which concerns itself primarily with the development of the art of bloodless operating. Bearing incidentally on the vital problems of tetany and Graves' disease, but particularly on the question of resection versus extirpation—concerning the advisability of removing parts and of leaving certain parts of both lobes—is a paper by Mikulicz (1886),[249] which, although it appeared three years later than the date set for the termination of the period of our study, is of such interest and importance as to demand conspicuous recognition in the operative story of goitre. Surgical art and science owe many a debt to the brilliant and charming Mikulicz of the great school of Billroth.

J. Mikulicz. *Beitrag zur Operation des Kropfes.* Wien. med. Wochenschr., 1886, Bd. xxxvi, pp. 1, 40, 70, 97.

In the three years from 1883 to 1886, as director of the surgical clinic of Krakau, Mikulicz performed 25 strumectomies without a fatal result. In seven cases the entire gland was excised; in eight, one lobe; in two,

the middle lobe or isthmus; and in eight, resection according to a new method of his own which he describes for the first time in this paper.

Union by first intention was obtained in 20 cases. In one instance tracheotomy had to be performed; the wound, unclosed, was packed with iodoform gauze. In every case but one the indication for operation was an extreme degree of dyspnoea from pressure of the goitre. "It is superfluous to state," writes Mikulicz, "that in every case in which the necessity for operation was not urgent, iodine treatment was first tried, usually in the form of parenchymatous injections." The excised tumor was in 24 cases a "benign parenchymatous or cystic goitre." * In one instance it was a carcinoma. The goitre in one patient was complicated with Morbus basedowii (Case 23). The symptoms of Basedow's disease rapidly and, without doubt, unexpectedly subsided after the operation. In performing his operations Mikulicz followed implicitly the principles formulated by Billroth which his "friend Wölfler in numerous papers has so admirably described."

His purpose in writing the paper he gives as follows:

"The number of my cases is surely too small to affect particularly the operative statistics which we already possess of hundreds of cases of goitre; at most, they furnish, in this respect, material from a little-known goitre region, the Galician Carpathians, confirmatory of the experiences of surgeons in other lands in which goitre abounds. Nevertheless, I shall not hesitate to narrate my experiences, since they may shed light upon a matter which today dominates the whole question of operation for goitre. I refer to the general and local disturbances—tetany, cachexia strumipriva and paralysis of the muscles of the larynx—which follow strumectomy and which, together, demand either an essential curtailing of the indications for operation or a modification of the operative method. There is hardly an operation within the past few years which has given the surgeon so much gratification and, at the same time, so much anxiety and perplexity, as the extirpation of goitre. Thanks to the efforts of Billroth and Kocher and to the influence of the antiseptic treatment of wounds, the technique of strumectomy has, in a short time, been so highly perfected that one, soon, will not hesitate to perform, solely for cosmetic reasons, an operation which Dieffenbach shuddered to contemplate.

"In fact, the antiseptic method guarantees to the wound from a goitre extirpation a healing more perfect than is seen in any operation of like magnitude. According to the latest statistics of Rotter there have been only 12 deaths in consequence of wound infection in 405 extirpations of non-malignant goitre in the period from 1877 to 1884. The brilliant results of Billroth and Kocher are well known. Several operators have had the good fortune to operate upon a series of cases without a mishap. Thus Pietrzi-

* Mikulicz, in a footnote says: "The classification of the adenomata as given in the splendid paper of Wölfler (*Ueber die Entwicklung und den Bau des Kropfes*, Berlin, 1883) was, unfortunately, not observed in the clinical histories, hence in this respect I am unable to specify the precise character of the growth."

kowski [275] reports 21 strumectomies successfully performed by Gussenbauer; and I have been so fortunate as to have had 25 operations without meeting with a death, although among these was one for Basedow's disease and one for struma maligna in which tracheotomy had to be performed—a complication which affects badly the prognosis.

". . . . Inasmuch as total extirpation complicates the wound conditions no more than partial excision of the gland, and since recurrence may take place, the former operation has more frequently been performed; indeed, Rose has advised that the radical procedure be made the rule. And already most surgeons had manifested a disposition to follow Rose's advice, when Kocher in his well-known address [192] on *Cachexia strumipriva* before the Twelfth Congress of Surgeons in Berlin took a decided stand against the total extirpation of the thyroid gland.

"A dissonance in the rejoicing over the goitre operations had already earlier been sounded by the frequently observed disturbances of the innervation of the muscles of the larynx. One referred these, however, at the outset, solely to rough injury of the recurrent nerve, which, it was hoped, would in the future, with the development of a finer technique be possible to avoid.

"Greater uneasiness was aroused by the tetany following thyroid operations, which was announced first from the clinic of Billroth. However, fatalities from this cause had only rarely been recorded. Liebrecht [214] in 351 operations met with only three deaths from this cause—and in the milder cases the attacks had been permanently or temporarily controlled by chloral hydrate and other means.

"Without doubt it was the communications of Reverdin [262] and Kocher [192] concerning the so-called cachexia strumipriva which brought to most surgeons the conviction that the removal of the entire thyroid gland, notwithstanding antisepsis, was no harmless intervention. The sad results of total excision painted in such vivid colors by Kocher were soon confirmed by other observers. Julliard,[178] Baumgärtner,[13] Grundler [142] (Bruns clinic), and Pietrzikowski (*l. c.*, from Gussenbauer's clinic) have reported similar observations, so that now the number of cases of cachexia strumipriva has reached 36. To this collection I can add a case of my own which conforms to the picture delineated by Kocher.

"It is comprehensible that in the face of such lamentable experiences a vigorous opposition to the total excision of the thyroid gland should have manifested itself. And when Schiff, Wagner, Zesas, Horsley and others, from experiments on animals, had confirmed the above-cited experiences, one must acknowledge that they are not wrong who affirm that extirpation of the thyroid gland is, physiologically, prohibited.

". . . . But how shall we act in the future when confronted with cases which, notwithstanding, urgently demand excision of both lobes of the thyroid gland? By ignoring the facts, as Maas and Rotter do, progress towards the solution of the problem will surely not be made. I hold that the matter of cachexia strumipriva has certainly not altogether been cleared up; for me, furthermore, the causal relation between strumectomy and cachexia has not as yet been proved in all instances. I believe, at least, that not all of the described cases of cachexia are identical, and that,

furthermore, the manifestations in many of them were not in consequence of the operation, but supervened independently. . . . . As long as it is not absolutely proved that the cachexia described by Kocher stands in no causal relation to the total excision we must, as much as possible, avoid this operation. Only in the case of malignant neoplasms is it unquestionably justifiable.

". . . . After all, is it not questionable whether the term cachexia strumipriva, selected by Kocher, is pertinent? As is well known, most varied hypotheses have been advanced in explanation of this sequel of total extirpation. This matter has already been so much discussed that it would not be worth while to consider analytically all the explanatory hypotheses which have been advanced, for we are not yet in possession of sufficient data to justify attempts to explain the symptoms of cachexia strumipriva. Only this much seems to me in high degree probable, that the acceptance of a specific function of the thyroid gland, as suggested by Reverdin, Bruns and others—be this the furnishing of a specific secretion or a contribution to the constituents of the blood or an activity (vaso-motor) regulating the circulation of the brain—does not suffice to solve the problem. Against this view are the facts that the cachexia may occur at any period of life, and that these symptoms are not present in the majority of the patients operated upon. Furthermore, Kocher's theory of deficiency of oxygen due to atrophy and softening of the trachea does not seem to be in accord with the facts. Most plausible to me is the view of Baumgärtner, who ascribes the symptoms to disturbed innervation in consequence of direct injury to or later changes (cicatricial contraction, atrophy, suppuration) in nerves in the neighborhood of the field of operation. This would most satisfactorily explain why in one case there appear the severest manifestations, and in another none whatever.

"This conception would also best account for the altogether inexplicable occurrence of tetany after the operation as well as, aside from the paralysis of the recurrent nerve, the innervation-disturbances of the larynx. As regards the origin of the tetany, Billroth attaches particuar importance to the severance of the numerous nerves of the gland, and N. Weiss considers it probable that the irritation of peripheral sympathetic nerves set up by the ligation of so many vessels brings about an active excitation of the vaso-motor centres of the medulla oblongata and cervical cord. The tetany and the consecutive innervation-disturbances of the larynx furnish, moreover, two further reasons which decidedly contraindicate excision."

Mikulicz then calls attention to a theretofore unreported sequel of total extirpation, viz., epileptic * attacks, which he had observed in two cases. In both instances tetany preceded the epileptiform seizures. In three of Mikulicz's seven total excisions of the thyroid tetany developed.

"As to the occurrence of tetany after total extirpation, it is frequently of brief duration and passes off without further consequences. But some-

* Epilepsy has repeatedly been observed in cases of parathyroid privation (Westphal, Schultze, Hochhaus, Phleps, Halsted and others).

times it terminates fatally (according to Liebrecht, three times in seven, and to N. Weiss, twice in 13 cases) . . . . In one of my cases of tetany the manifestations of cachexia strumipriva appeared later. This observation, which also Gussenbauer * had made in two cases, points to the association of the two affections. It is quite conceivable that both of them have origin in the same disturbances of innervation; namely, lesions of nerves in the vicinity of the thyroid gland."

These early experiments on human beings have particular interest for us because they will not be repeated except by accident or through ignorance or in cases of malignant tumor. In animals they can be duplicated exactly. Thus, in dogs, after complete extirpation of the thyroid and parathyroid glands with transplantation of the latter in a film of the former, symptoms of parathyroid deprivation appear promptly, but the myxoedema, coming on slowly, does not usually attain its maximum development for several months (Halsted). In three of my dogs the maximum myxoedema, reached in three or four months, was maintained for a month or more and then, gradually subsiding, disappeared. The promptly appearing symptoms of parathyroid deprivation cleared up more or less completely with the revivification of the transplanted glandules, whereas the manifestations of thyroid deficiency vanished only commensurately with the slow compensation from hypertrophy of the thyroid graft.[151] In the three dogs referred to only a tiny film of thyroid tissue was transplanted—just enough to make possible, without injury, the transference of the parathyroid gland from the neck to a preperitonaeal pocket.

Injury to the recurrent laryngeal nerve is considered by Mikulicz at considerable length:

"As to the paralyses of the larynx muscles, they can occur after one-sided as well as after total extirpation of the goitre. Experience teaches, however, that they are much more likely to follow the complete excisions.

"Jankowski,[173] in a meritorious contribution, has collected the hitherto observed cases of paralysis of the laryngeal muscles after goitre excision. Paralysis occurred 87 times in 620 operations—14.03 per cent.† Of these 87 cases, 65 occurred after total, and only 22 after partial, extirpation of the goitre—a proportion of about three to one. But one must reflect that the partial operation has been practised much more frequently than the total. According to the statistics of Liebrecht, there were, in 303 accurately described operations, 125 total and 178 partial extirpations. If we make our calculations from these figures we must conclude that paralyses of the laryngeal muscles occur more than four times as frequently after total as after partial excisions of goitre.

* *Vid.* Pietrzikowski, *l. c.*

† Undoubtedly the paralysis occurred much oftener than this. Laryngeal examinations were not made as a matter of routine.

". . . . The question whether in each case of vocal cord paralysis a coarse injury, a division of the nerve, has taken place, I must, as result of my experiences which correspond with those of other surgeons, answer decidedly in the negative. I have, in each case, isolated the nerve with the greatest care, and, until it was clearly in view, have not proceeded to the ligation of the inferior thyroid artery or its branches. In Vienna I saw a great number of goitre operations performed by the masterhand of Billroth and learned the topography of this region under the most difficult relations. Nevertheless, it befell me to observe, in my 25 operations for goitre, a paralysis of the vocal cord in one case, and, in three cases, increase of a preexisting hoarseness."

In his third paper Mikulicz [249] explains how it happened that he hit upon the operation which he is about to describe—an operation which, with slight modifications, is the one which a number of surgeons, myself included, perform today. Most operators, particularly those who ascribed to the thyroid gland some special function (*i. e.*, regulation of the circulation of the brain), advised, following the lead of Kocher, the removal of only one-half of the goitre. Mikulicz, for reasons given in quotations which I have made from his papers, also discarded the total or radical operation.

"But it not infrequently happens," he writes, "that, having undertaken the operation with the intention of removing only one lobe, the surgeon finds it necessary to remove the other. I have several times found myself in this predicament. After a very large, forwardly displaced lobe had been excised there would appear for the first time the second lobe which had been concealed behind the trachea, which it surrounded, or been buried in great part behind the sternum. In such cases one takes a risk if he postpones removing this lobe in the expectation that it may atrophy. It was in a case of this kind that I first practised a method which I hope may best prevent the evil consequences of total extirpation. I extirpated, namely, the second lobe, only in part, resecting in such manner that a portion of the lobe remained in the neighborhood of the inferior thyroid artery.

"I ventured to do this because I had observed that *division and ligation of a quite massive isthmus could be accomplished without evil consequences;* * the parenchyma of the thyroid gland must, therefore, be tolerant of the insult caused by ligature *en masse*. Hence I need not fear to sever the principal part of the goitre from the remains by means of mass-ligatures passed through the parenchyma."

Surgeons from the time of Desault had not hesitated—indeed, they were compelled—to cut or crush through the parenchyma, distal to their ligatures or écraseurs. But what Mikulicz evidently had in mind was the behavior of these crushed tissues in a wound treated antiseptically—a wound which should heal by first intention.

* Italics mine (W. S. H.).

He did not fear haemorrhage as he must have done three years earlier when assistant to Billroth who, in 1883, in discussing Weiss's paper (*l. c.*) said: "Were we compelled to cut through the middle of the goitre we should be confronted with a quite uncontrollable haemorrhage." Hence resection of a goitre in a wound to be closed was, *per se,* a definite contribution.

From Mikulicz's account of the first operation by his new method of resection it will be interesting to have recorded here the more important paragraphs:

"The very first attempt which I made (case No. 13) pleased me exceedingly. The patient, a peasant boy, aet. 16, was suffering from great dyspnoea and hoarseness. The trachea, dislocated forwards, was compressed to such a degree of flatness that one could feel through the skin only a narrow ridge. On the 19th of May I began the operation with the intention of removing the left lobe and isthmus and with the hope that the right lobe might be left undisturbed. But in the course of the operation it developed that the latter lay chiefly under the sternum and might of itself prove a danger. Accordingly, I isolated the lobe, so far as this could be done by blunt dissection, in the customary intracapsular manner. The bleeding vessels were, as usual, doubly ligated with catgut. Furthermore, in typical fashion, I tied the superior thyroid artery and vein at the upper pole, and also the superficial vessels running to the lower pole. Next, with little snippings of the scissors, I freed from the anterior and lateral surfaces of the trachea the adherent lobe, taking care to avoid dissecting too far posteriorly, for fear of injuring the recurrent nerve. Finally, the entire goitre was bound only in the angle between the trachea and esophagus, just where the recurrent nerve and the inferior thyroid artery lie buried. This adherent part at the hilus of the gland I treated as if it were a short, thick ovarian pedicle. While an assistant made pressure with the fingers on the vessels entering the hilus, I split the 'pedicle' longitudinally with the blunt scissors into several portions, clamped each portion with a haemostatic forceps and tied with catgut in the line of the clamp-made furrows. Only now did I proceed to cut away the goitre-mass which, in this manner, had been isolated. The pinces hémostatiques crushed out, in line with their blades, almost the entire parenchyma of the gland, so that in the ligature-furrow little remained but the connective-tissue stroma and the blood vessels. . . . .

"The remaining stump of the gland, contracted to a nodule the size of a chestnut, rested in the angle between trachea and esophagus. Neither the inferior thyroid artery nor the recurrent nerve was seen." *

Mikulicz calls this procedure a resection, to distinguish it from the typical extirpation of one or both lobes.

* "The application of ligatures *en masse* to the 'base' of the goitre prior to its ablation was made by operators as early as the end of the last and beginning of the present century, and is related in the *Operationslehre* of Günther and the *Operative surgery* of Dieffenbach."

In the manner described he operated upon seven additional cases (Nos. 16, 19, 20, 21, 23, 24 and 25).

Upon four of these, just as in the first case, a lobectomy having been done on one side in the typical Billroth manner, it was found necessary to remove the greater part of (viz., to resect) the second lobe. In two cases resection of one lobe was done for the removal of a circumscribed nodule, the other lobe remaining untouched. In only one case (No. 23) were both lobes resected.

"It is noteworthy that in case 23, already several times referred to, the symptoms of Basedow's disease rapidly improved after the resection—a result which Tillaux and Rehn had already observed."

Case 23: Peasant woman, aet. 35. Goitre, the size of two fists, involving the entire gland had been developing for eight years. Pronounced symptoms of Graves' disease—dyspnoea, cardiac hypertrophy, tachycardia, exophthalmus. Operation June 26, 1885: Kocher's Winkelschnitt. Resection, by the Mikulicz method, of both lobes. Prompt recovery. October, 1885: Patient wrote that her voice was clear, her breathing free and that the palpitation of the heart had ceased. Only the exophthalmus was still noticeable.

Mikulicz recommended his resection method at a time when he did not believe that the thyroid gland was a vital organ and did not attribute cachexia strumipriva to the forfeiture (Ausfall) of a secretion. Indeed, he questioned the propriety of adopting this nomenclature of Kocher believing with Baumgärtner that the symptoms might most plausibly be ascribed to disturbed innervation in consequence of direct injury to or later changes in nerves in the neighborhood of the field of operation.

Kocher had suggested that deficiency of oxygen, due to atrophy and softening of the trachea, might account for the picture, not, however, discrediting the view that the thyroid's function might be to regulate the supply of blood to the brain. He did not believe that cachexia strumipriva was due to the loss of a secretion, for he wrote:

"The change in the condition of the patient cannot be explained by the elimination of the function of the thyroid"; and again: "We believe that the symptoms which condition the picture of idiocy are probably determined by the influence upon the breathing, upon the supply of oxygen, in so far, at least, as it may not be ascribed to the cutting out of that function of the thyroid gland which serves in the formation of the blood."

As to the cause of tetany Mikulicz was inclined to agree with Billroth who, in discussing Weiss's paper, had expressed himself as follows:

"I am inclined, therefore, to lay especial stress upon the division of the numerous nerves of the thyroid gland, and believe that tetany occurs only in those individuals who are predisposed to nervous affections."

Hence, Mikulicz planned his operation of resection not with the idea of leaving to the patient a portion or portions of a vital organ. He merely knew that removal of the entire gland was likely to be followed by Kocher's cachexia strumipriva or tetany, or both. He feared, also, recurrence of the goitre and injury to the recurrent nerve, and his operative experience had taught him not only that sometimes it was imperative to excise the greater part of both lobes in order to relieve pressure upon the trachea, but also that neither cachexia strumipriva nor tetany occurred if a portion of even one lobe were left. If so much is to be gained by leaving a part of one lobe, why not leave parts of both, he undoubtedly asked himself. For cosmetic reasons, and also to protect the laryngeal and possibly other nerves, the posterior portions of the lobes would naturally have been the parts left to the patient.

It would not be especially interesting to trace further the tardy development of the operation of thyroidectomy in England, France, Italy and America. Progress in operation upon the thyroid in this country has been made chiefly since 1890 and by those who were familiar with the advanced work of the Swiss, Austrian and German surgeons—of Victor von Bruns, Billroth, Lücke, Kappeler, Kocher, Reverdin, von Gussenbauer, Wölfler, Baumgärtner, Mikulicz, von Eiselsberg, Payr, Schloffer and others.

On my return from Germany in 1881 I was impressed with the fact that our surgeons were greatly handicapped in most of their operations by lack of proper instruments, particularly of artery clamps. These were insufficient in number and faulty in design. In most of the New York hospitals the only artery clamps were of the fenestrated, mouse-toothed, spring forceps variety (Liston's and Wakley's), indeed, these were about the only ones procurable either in this country or England. In the elaborate catalogue for 1882 of S. Maw, Son and Thompson, London, no other artery forceps, torsion forceps excepted, is mentioned.

In a catalogue of Collin et Cie, Paris, undated, but evidently of about the same period, the little artery clamps of Koeberle and of Péan are the only ones figured; " pinces à artères à ressorts " are catalogued, the latter probably being the mouse-toothed forceps given in the London catalogue (Maw and Son) and quite universally employed in America until 1880 or a little later.

In Günther's *Surgery* (vol. i, Plate 5, opp. p. 36) is a remarkable lithograph (*vid.* Plate XCIV, 3) which indicates the part played by the tenaculum in haemostasis in 1859. The divided artery, open-mouthed, is hooked up on the point of the instrument, the handle of which is held in the mouth of the operator who, evidently, was short-handed. Until about 1890 the

tenaculum was a favorite instrument in America for checking haemorrhage, especially with some of the senior surgeons, and until about 1880 was quite universally employed here, its only rivals being the inadequate mouse-toothed, spring forceps and the Péan or Koeberle clamps. Then almost simultaneously came the clamps of Spencer Wells * and (1879) of the writer, of which the Péan-Koeberle clamp was the prototype. The point of my clamp was snub-nosed originally, but the length and spread of the handles, the essentially new features, were the same as at present. With the development of the transfixion method with milliner's needles and the use of the fine black silk, the nose of the clamp was made finer (1889). Two or three years later it assumed its present form (Plate XCII, 5).

Rarely had I seen in our country, prior to my first visit to Europe (1879), more than one artery clamp at a time left hanging in a wound. Clamps were too few for this—four to three or even two being considered ample for an operation. Few hospitals, in New York at least, possessed as many as six artery clamps in 1880. I recall vividly an operation in Vienna performed by Mikulicz in 1879 in Billroth's clinic. Americans, newly arrived in Austria, we were greatly amused at seeing perhaps a dozen clamps (Schieber) left hanging in a wound of the neck while the operator proceeded with his dissection, and were inclined to ridicule the method as being untidy or uncouth. Slowly it dawned upon us that we in America were novices in the art as well as the science of surgery.

The artery forceps, adequate in number and design, undoubtedly played a very important rôle in the strikingly rapid progress in the art of operating made by surgeons, the world over, in the final quarter of the past century.

Retractors of proper size and form are essential, particularly when one is working through a small incision, as in thyroidectomy and in ligation of the inferior thyroid arteries. Valentine Mott used a thin piece of board 3 inches wide and curved spatulas in his remarkable case of ligation of the common iliac artery. Volkmann contributed the many-pronged, grab-rake-like retractors. The blades of the retractors used in the general surgical clinic of The Johns Hopkins Hospital, specially designed in 1888, are all concave † from side to side and, for the most part, convex in the long axis of the instrument. They are solid and provided either with short teeth or with a curled lip (Plate XCIII, 2, 3 and 4).

* I have been unable to ascertain the precise data of introduction of the Spencer Wells clamp.

† I have heard that Sir Victor Horsley, prior to 1888, had employed, in operating upon the brain, a retractor, concave from side to side; but at the time when our instruments were designed, concave retractors were not to be found in the instrument shops of London, Paris, Hamburg or Berlin.

The scalpel of our clinic has a handle designed for use as a dissector. Every surgeon instinctively makes dissecting strokes with the handle of his knife, but these motions are futile and hence false unless the tip of the handle has the proper form (Plate XCIV, 2 and 3). Aneurism-needles we use much less frequently than formerly in our thyroid and other operations, for by transfixing the tissues contiguous to the vessels, or the vessels themselves when large, a single thread of fine silk gently tied suffices where, otherwise, several strands of considerably heavier silk, forcibly tied, would be required in order to guard against slipping of the ligature.

Aneurism-needles are convenient, and sometimes essential, particularly in the ligation of undivided arteries in a deep pocket. Here we use the form shown in Plate XCII, 3. A thread, knotted into a tuft at one end, is passed through the little hole at the tip of the instrument on a milliner's needle. The black tuft, pulled home either before or after the artery has been circumvected by the aneurism-needle, is easily recognizable and picked up by the assistant. The little curved needles (Plate XCII, 4) have an eye in the middle, and are flattened in order that they may be firmly clasped by the pointed artery clamp which delivers, as well as by the one which receives them. We have rarely employed this form of aneurism-needle. A simple contrivance which we frequently make use of is a threaded needle broken short and held in an artery clamp at the desired angle (Plate XCII, 5). I take pleasure in expressing my appreciation of the care given by the late Wulfing-Luer of Paris to the making of almost all of the surgical instruments originally purchased for The Johns Hopkins Hospital and designed by the author, and my thanks to his sons for many subsequent courtesies. Our instruments, with few exceptions, were fashioned from original designs; the handles, also, had all to be made to order, for at that time (the winter of 1888 and 1889) the handles of instruments in France and England were of wood or bone or ivory—occasionally of hard rubber. In Germany, Dannenberg of Hamburg, at the suggestion of Schede and of Kümmel (originator of the inorganischer Verband), was making metal handles for many of the instruments, and Schmidt and Windler of Berlin for scalpels.

Many times during the past 20 years I have stood by the side of Professor Kocher at the operating table enjoying the rare experience of feeling in quite complete harmony with the methods of the operator, and it is a pleasure to give expression to the sense of great obligation which I feel to this gifted master of his art and science.

Professor Kocher acquired surpassing skill in the use of the "Kropfsonde" and aneurism-needle. For some 40 years they were his weapons in

his battle with the veins and arteries of the neck. A surgeon employs the instruments which in his hands he finds most effective. My chief weapon against haemorrhage is the artery clamp, a finely pointed instrument which can penetrate and dissect and does not crush the tissues in unnecessary measure. There are times when some form of aneurism-needle is indispensable, as, for example, in the operation for ligation of the inferior thyroid artery through a short incision in the presence of a large goitre.

Tissues included between two ligatures are more or less tense according to the distance between the latter; on being divided these tissues become lax and thus loosen the hold of the ligature. To prevent slipping of the ligature under these circumstances, force sufficient to crush the enclosed tissues would have to be exercised; the greater the force the greater must be the strength of the ligature. Thus Professor Kocher found it necessary to use three or four strands of silk, which we should consider coarse, in tying off the blood vessels of the upper pole of a goitre, and emphasizes the necessity of using crushing force. Is it not a more rational procedure to transfix some part of the tissues to be ligated and use a fine thread for the ligature which, thanks to the transfixion, may be tied with just force enough to stop the flow of blood? The clamp should always be removed as the first turn of the knot is being drawn home; otherwise, as every surgeon knows from experience, the grip of the tie may be loosened, and the ligature, if not a transfixing one, may slip away. The surgeon who has become convinced of the importance of devitalizing tissues as little as possible will not only employ the finest adequate silk, but will, as he ties, note the force necessary to check the haemorrhage, and use no more. By practice the operator acquires a delicacy in tying, and develops a particular sense which enables him to gauge with accuracy the amount of pull which, for example, a thread No. 00 will permit.

THE AUTHOR'S OPERATION

The window in the top operating sheet is fastened to the skin with fine stitches, two of them, exactly in the midline, serving as a guide in bringing together the lips of the wound. Formerly the midline stitches were placed as shown in Plate LXXXV, 1, the sheet being clamped to the skin, in clumsier fashion.

A collar incision is usually made in the line of a wrinkle over the centre of the tumor, but sometimes a little nearer to the upper than the lower poles of the thyroid lobes, and occasionally just above the sternal notch, conforming exactly to the curve taken by a trial necklace. It should be

carried only very slightly, if at all, upwards at the ends, because the greater the departure from the transverse to the vertical the more unsightly becomes the scar. The platysma muscle, having been divided, is dissected upwards with the skin-flap, the veins being carefully avoided (Plate LXXXV, 2). The lower flap is not dissected free throughout its entire extent; but in the midline it is reflected low enough to expose the manubrial notch. In splitting between the sternohyoid muscles, veins which may cross the midline are ligated, by the transfixion method if necessary, with the finest silk. The sternohyoid and omohyoid muscles are gently raised away from the sternothyroid, the extent and thickness of which is noted. On retracting the muscles of the neck outwards an accessory thyroid vein (or two) is occasionally brought into view, stretching obliquely or transversely across the space to the thyroid gland. These vessels we ligate with the assistance of the broken, threaded needle (Plate XCII, 5). They should be secured at this stage of the operation, before the sternothyroid muscle is stripped from the gland, otherwise they may be torn and prove troublesome. When the sternothyroid is thin and narrow, its posterior border may be hooked up with a broad vein-retractor and pulled mesially far enough to expose the superior thyroid vessels sufficiently well; but, ordinarily, we retract this muscle outwards or split it longitudinally in line with these vessels. It is a mussy procedure to cut across and then push up and down the divided fibres of the sternothyroid. The dissection is much cleaner if the muscle is split or, better, merely retracted (Plate LXXXVI, 1 and 2).

The superior pole of the lobe can now be hooked forward with the index finger without fear of tearing a blood vessel. Two clamps are applied near this tip of the gland (Plate LXXXVI, 2), the upper one about 1 cm. below the entrance of the vessels to the pole. The gland is cut across between these clamps to about the situation of the mesial branch of the artery, when one or two more clamps are applied and the gland is further divided to the trachea (Plate LXXXVII, 1), which at this juncture is usually bared to the upper edge of the isthmus.*

The lobe is then rolled inwards over the trachea and the loose, extrinsic capsule divided and gently sponged back with the Breslau or "Küttner"

* The seizure of the upper pole with the artery clamps, in all cases advantageous, is especially helpful when the tip of the lobe is long and slender and extends far up and behind the trachea or esophagus and is difficult to engage with the finger. Under these conditions it may be necessary to apply, in the line of the incision through the pole, a number of clamps in pairs, the gland, as it is drawn forward by the clamps, being divided between them as each pair is placed.

roll.* The fine-pointed artery clamps of our clinic are then applied, as shown in Plate LXXXVII, 2, and its insert, only in greater number. The vessels, arteries and veins are clamped well away from the parathyroids and the recurrent nerve. I have never advocated ligation of the trunk of the inferior thyroid artery.† The clamps being placed as depicted, the lobe is rolled outwards (Plate LXXXVIII, 1), three or four vessels of the isthmus being clamped before dividing this structure, which is usually first separated from the trachea with a long, narrow, blunt dissector and then transfixed and gently ligated.

The lobe is now resected from within outwards, just distal to the encircling clamps. In the course of this slicing off of the gland, three or four more vessels have usually to be caught (Plate LXXXVIII, 2). Their positions are fairly constant and hence they can usually be recognized and clamped before being divided.

Fine milliner's needles, armed with silk No. A, whipped along the capsule in such fashion as to be buried in the glandular tissue, occlude the vessels and thus release the clamps. If there should still be the least oozing from the cut surface of the gland, the stump with its capsule is transfixed here and there in mattress fashion or otherwise (Plate LXXXIX, 1). Occasionally, but very rarely, and only when it rides forward, the raw surface of the stump of the lobe is opposed to the raw surface of the isthmus (Plate LXXXIX, 1). The little stump of the superior pole is then drawn down and transfixed with a short needle ‡ carrying a ligature of silk No. C. The transfixion is an almost indispensable procedure. As the ligatures passed in this manner cannot slip, very fine thread may be used, because only just enough force to close the vessel is required.

For subcutaneous vessels silk No. 00 is sufficiently strong. The fat is transfixed in the typical way and the hair-fine thread tied so gently that the tissues are not unnecessarily devitalized. When the tissues are ligated in this delicate manner, made possible by the transfixion, the wound is not studded with the stellar necroses which otherwise abound.

Special Features of the Operation Which Were More or Less Novel at the Time of Their Introduction into Our Clinic

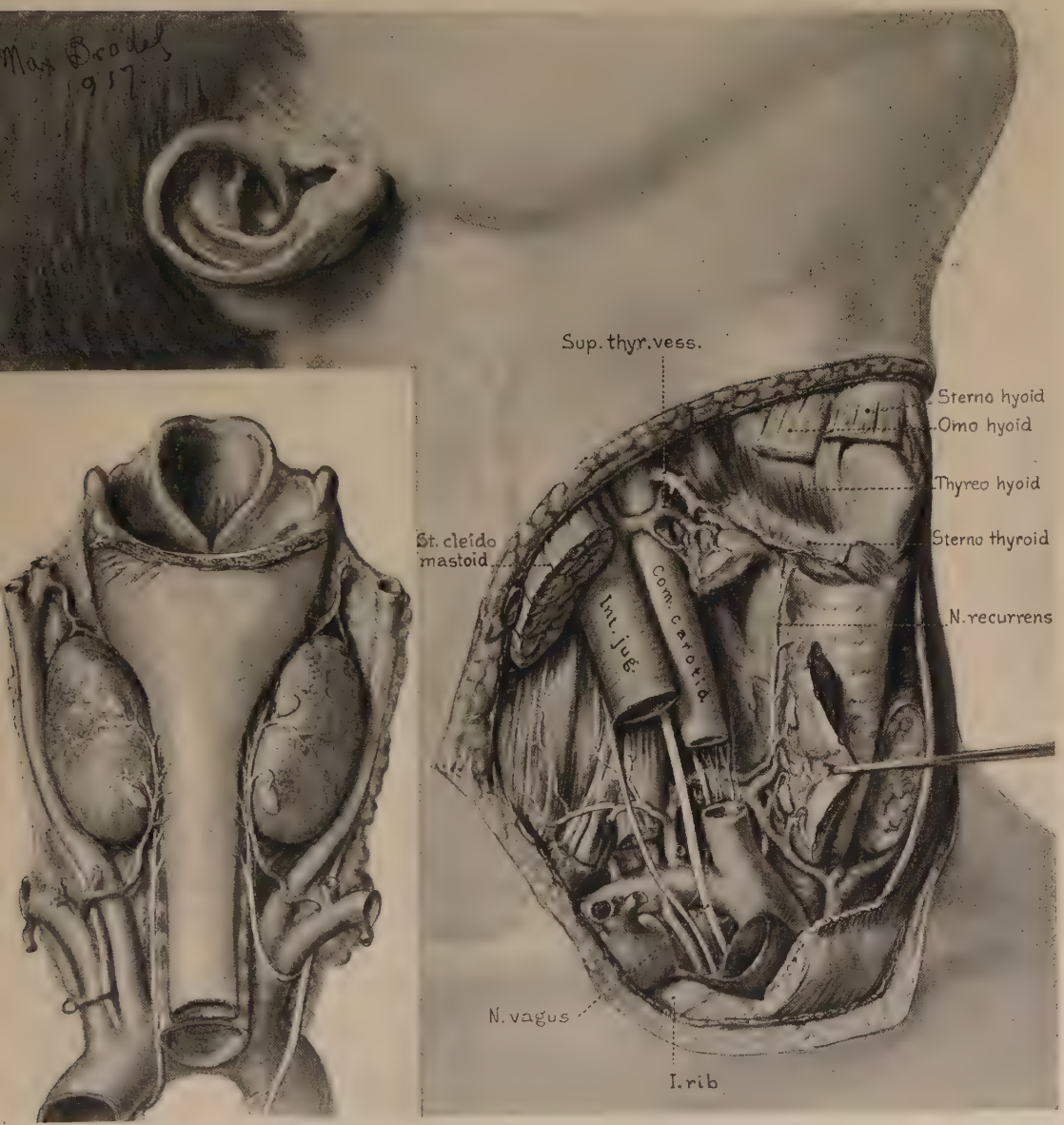
1. Preservation of the superficial veins of the neck.

2. No muscle except the platysma is divided—not even the sternothyroid—except in case of large or adherent goitres.

* This useful little roll of tightly wound gauze was devised by the orderly of the Breslau clinic in the days of von Mikulicz.

† I emphasize this fact because Professor de Quervain (Surg. Gyn. and Obst., 1916, vol. xxiii, p. 402), to whom I wish to express my compliments for his polite reference to my work, has misunderstood my procedure.

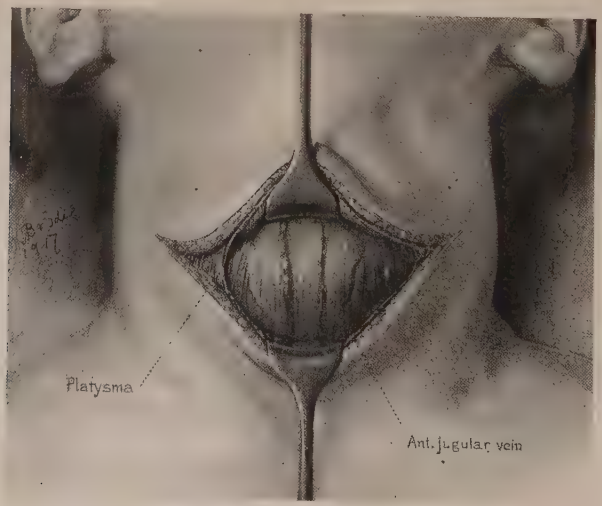
‡ This needle is shown in Plate XC, 1.



Dissection of the operative field. The right lobe of the thyroid gland has been removed in the typical manner, a slice having been left posteriorly in order to preserve the integrity of the parathyroid bodies and the recurrent laryngeal nerve. This slice is drawn toward the midline with a hook. The insert, slightly elaborated by Mr. Broedel, was drawn for the author by Mr. H. M. Evans in 1907 from one of many dissections made by the latter for his study of the arterial supply of the parathyroid glands.

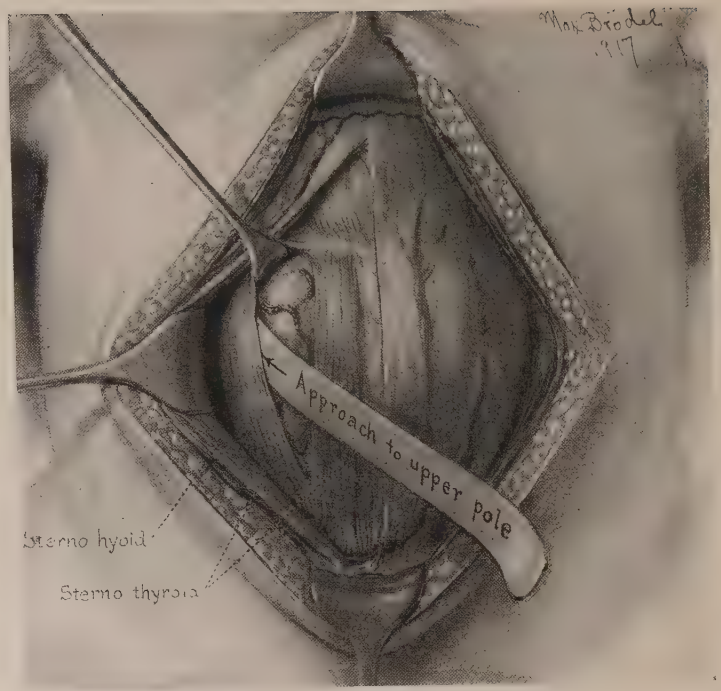
THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

1.—The little knots of silk mark the midline and guide the operator in closing the wound.

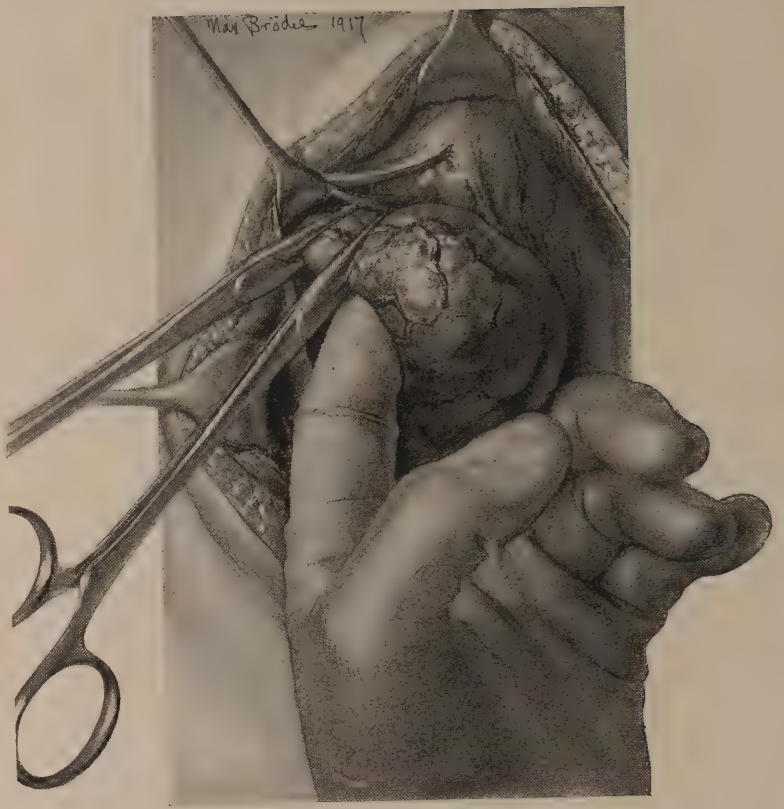


2.—The skin and platysma muscle have been divided.

THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

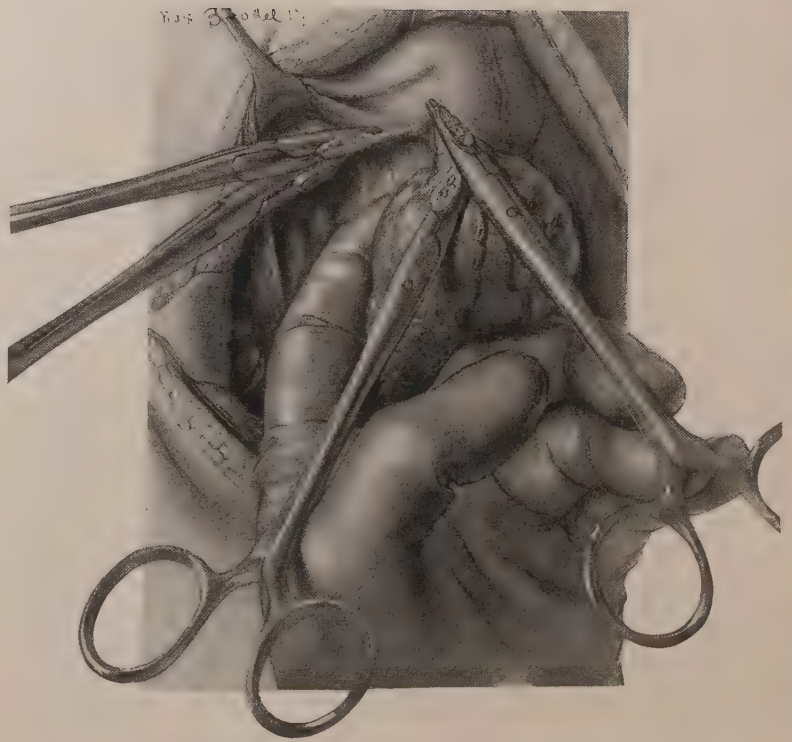


1.—The spatula introduced between the gland and the sternothyroid muscle is contributed by the artist in order to carry the lettering.

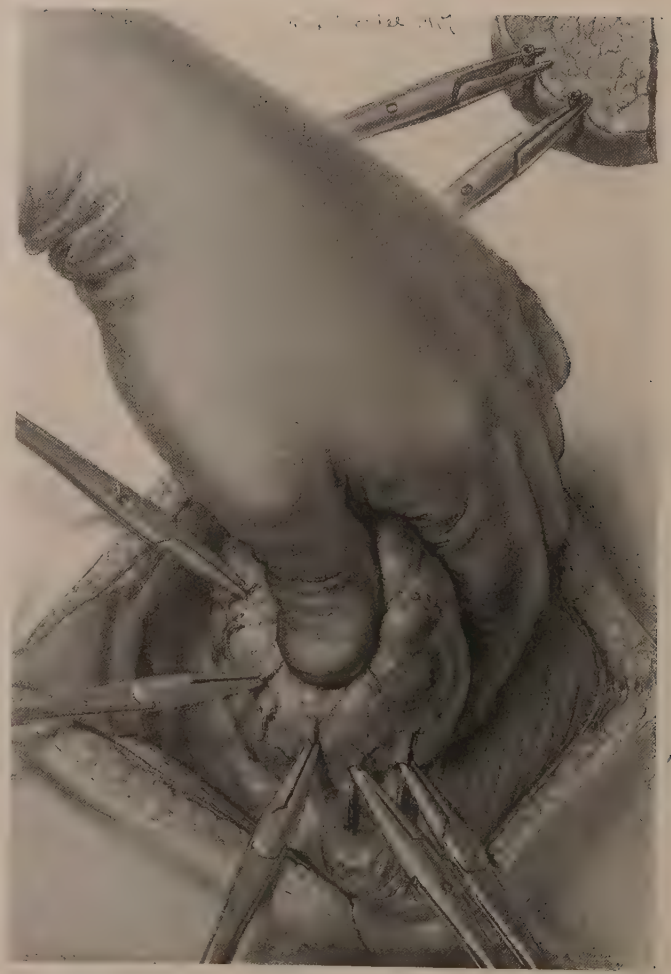


2.—At this stage of the operation the muscles are drawn away from the lobe by one broad, deep concave retractor instead of by the two small ones which in this and the preceding drawing serve to define clearly the two retracted muscles. The superior pole is caught between two finely pointed clamps.

THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

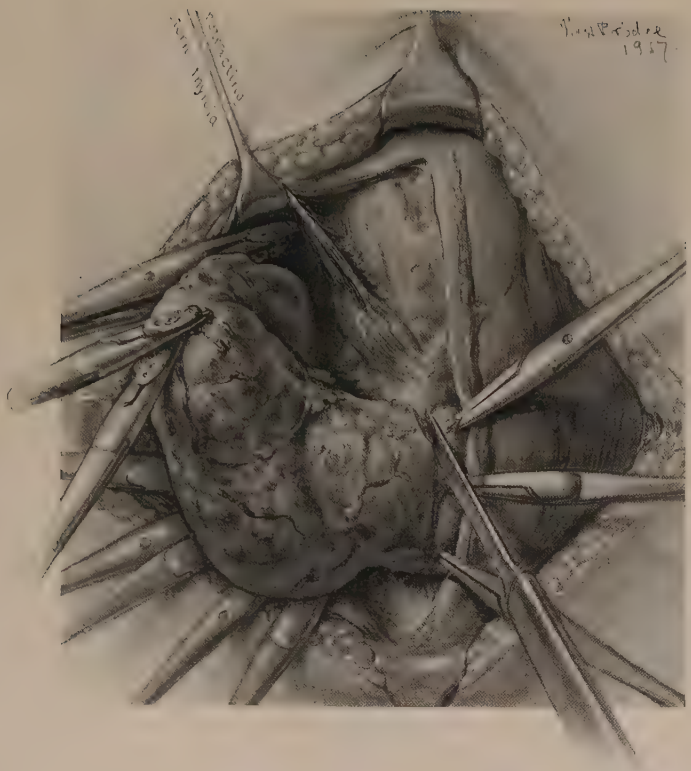


1.—The tip of the superior pole has been divided between the clamps.

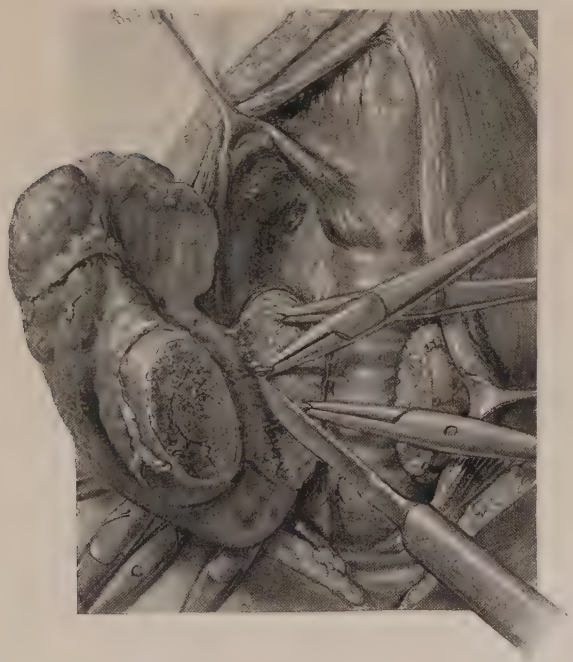


2.—The lobe is rolled inwards and the blood vessels have been clamped at a safe distance from the recurrent nerve and the parathyroid glands. Clamps are employed in greater number than is indicated in the drawing.

THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

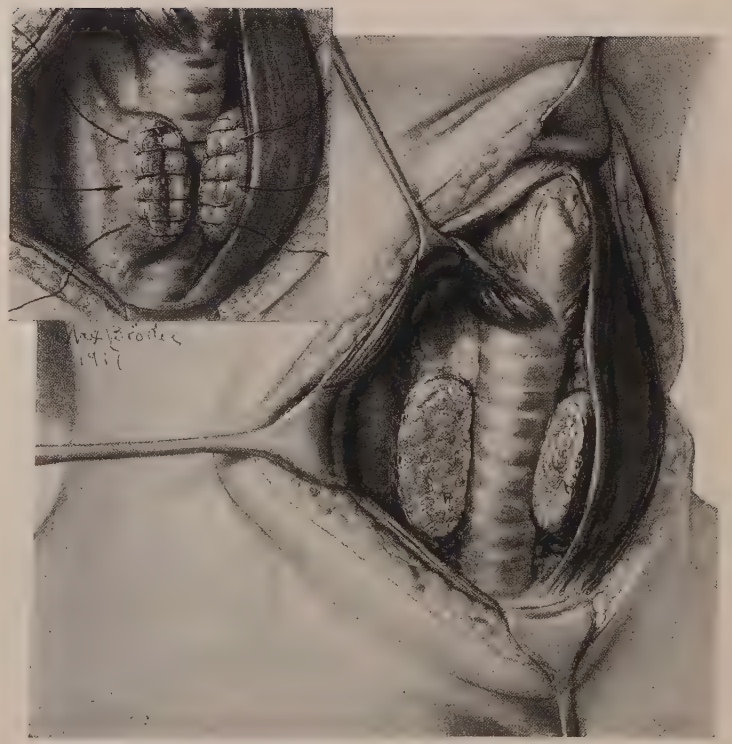


1.—The act of dividing the isthmus. Usually, before division, the isthmus is freed from the trachea by a slender blunt dissector and ligated on the hitherto undisturbed side.



2.—The isthmus has been divided, and the lobe, rolled outwards, is being sliced through just distal to the girdle of clamps shown in Plate LXXXVII, 2.

THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE



1.—Occasionally, but rarely, the stump of the excised lobe rides forward as shown in the insert; and in a few such instances I have sutured it to the stump of the isthmus. The stitches over this stump are usually of the mattress type; in any event they become buried on tying.

2.—The wound is closed without drainage. For the sake of clearness the artist has depicted a coarser silk than we use for these sutures.

THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

1.—The suture of the platysma muscle. Note the short straight needle which is much used in our clinic.

2.—Shows the central stitch in line with the landmarks above and below.

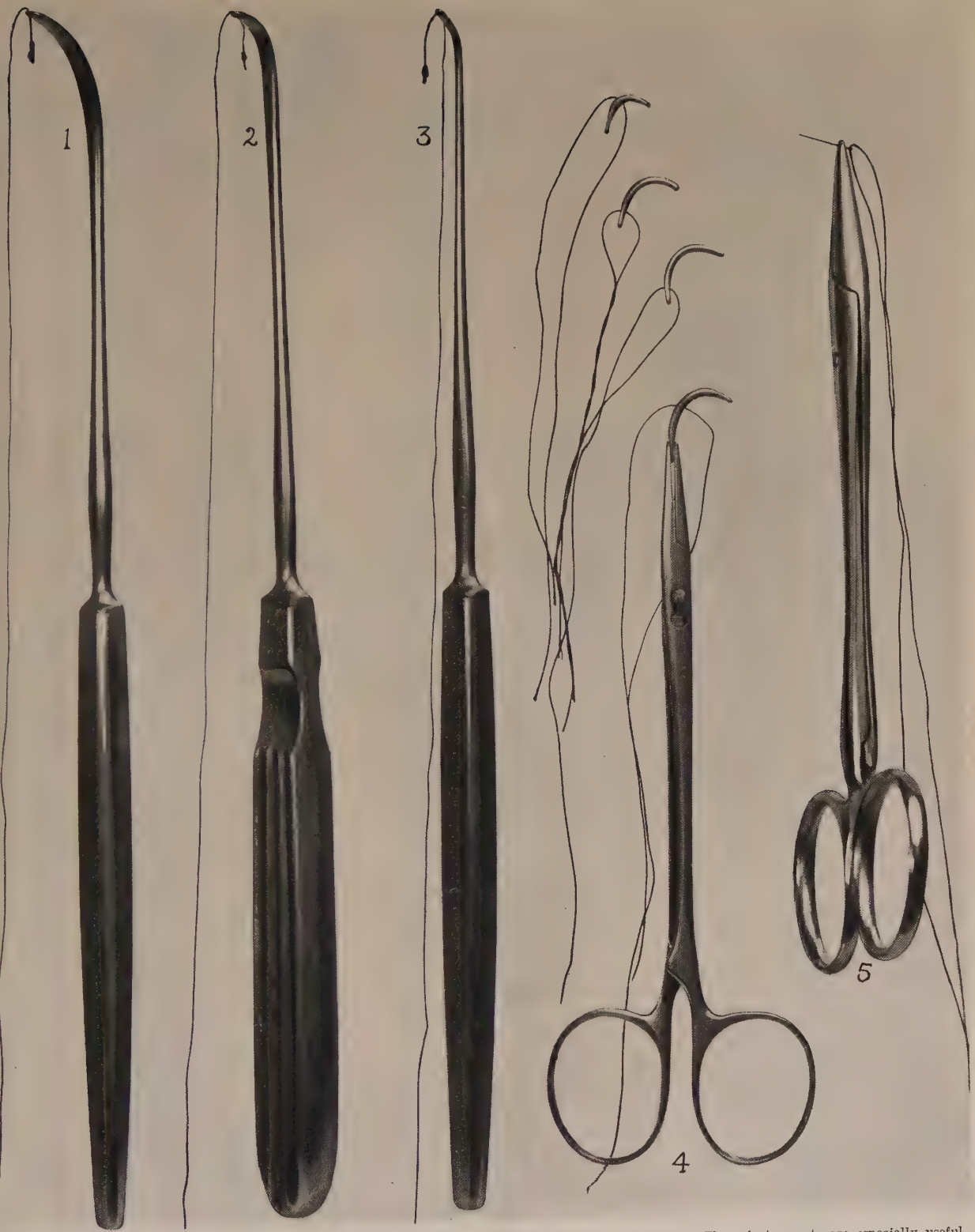
THE OPERATION FOR EXOPHTHALMIC OR HYPERPLASTIC GOITRE

1.

2.

1 and 2.—One of the methods which we employ in enucleating an adenoma. The lower clamp is applied as close as possible to the tumor which partly extrudes itself on removal of this clamp after the incision (2) is made between the clamps into or through the superior pole.

ENUCLEATION OF AN ADENOMA



1 and 2.—Curved, fine-edged dissectors armed with a thread in the manner described in the text. These instruments are especially useful in the ligation of large deeply situated vessels such as the common iliacs, the innominates (vein and artery) and the left subclavian and carotid arteries within the thorax. The fine thread serves as a leading string for the tape with which we ligate large arteries.

3.—Aneurism-needle employed in ligation of the inferior thyroid artery.

4.—Mosquito clamp carrying one of the semicircular aneurism-needles; unfortunately, it has lost its original delicate form in the hands of successive instrument makers.

5.—This clamp was a decided departure from the forms in use at the time it was designed, about 30 years ago. Except for a modification in the beak it is essentially the same as the clamp made for me in 1878 by Otto and Reiner of New York. The broken off cambric needle in its jaws is a ligature carrier—a form of aneurism-needle we frequently employ.

INSTRUMENTS DESIGNED BY THE AUTHOR IN 1888-89 FOR THE JOHNS HOPKINS HOSPITAL

1 and 1ª.—Two views of a retractor designed for use in the operation of ligating the inferior thyroid artery. The blades should be very thin, thinner than depicted, in order to take as little space as possible in the small, deep wound.
2 and 3.—Forms generally used in the clinic.
4.—Blood vessel retractor.

INSTRUMENTS DESIGNED BY THE AUTHOR IN 1888-89 FOR THE JOHNS HOPKINS HOSPITAL

3

1.—Blunt dissector for arterial work. The operator should use two of these in freeing an artery, an assistant aiding with a third.

2 and 2a.—Two views of the knife. The handle being hollow is well balanced, and its tip, drawn out to a fine edge, makes an excellent dissector.

3.—Taken from Günther's *Lehre von den blutigen Operationen am menschlichen Körper,* Leipzig, 1859, Vol. I, Plate 5, opp. p. 36.

INSTRUMENTS DESIGNED BY THE AUTHOR IN 1888-89 FOR THE JOHNS HOPKINS HOSPITAL

3. The sternothyroid muscle is retracted outwards—occasionally split longitudinally.

4. Delivery and division of the superior pole before the remainder of the gland is dislocated.

5. Resection in place of total lobectomy in order to protect the parathyroid glands and the recurrent laryngeal nerve and to preserve a slice of thyroid in case an operation might have to be performed, possibly by another surgeon, on the opposite lobe.

6. Ultraligation (well beyond the origin of the parathyroid arteries) of the blood vessels, all of which are clamped before the lobe is resected.

7. Ligation of the inferior thyroid artery is not practised.

8. Closure of the wound without drainage.* This is made possible by the use of fine silk and the transfixion method for the absolute arrest of haemorrhage.

Enucleation and Resection-Enucleation Operations for Adenomata

The discovery by Emil Goetsch, of our surgical staff, that the parenchymal cells of active thyroid adenomata are richly studded in the cytoplasm with mitochondria approximately proportionate in numbers to the toxic activity of the new growths clarifies a problem which has long perplexed surgeons, and accentuates the necessity of searching for and removing so far as possible all the adenomatous tissue of both lobes and isthmus. We now at last know that the symptoms of hyperthyroidism present in most patients with adenoma when they present themselves for examination, and quite surely present at some period in all, are due to the hyperactivity of the epithelial cells of the adenoma and not to stimulation of the surrounding, histologically normal thyroid tissue. Adenomata may be large or small, single or multiple. They may attain great size, be pendulous and extend to or below the umbilicus, or so small as to be invisible to the naked eye. The entire thyroid gland may be so studded with small adenomata, microscopic or macroscopic, that their removal by enucleation is not feasible and that only resection of the greater part of both lobes avails. In the case of such glands, which might be termed conglomerate, some of the adenomatous

* I am interested to note that in 1891 [147] I warned against the use of drainage tubes as follows: "It was not until the fall of 1889 that, for clean wounds, we discarded, absolutely, drainage in all of its forms. Since September, 1890, we have closed, without drainage, *all* wounds—the suppurating as well as the clean wounds." In those days all infected wounds were thoroughly cleansed by excision and prolonged disinfection just as in our blood-clot cases, and closed loosely, tension being studiously avoided.

tissue must be left in the slice from each lobe which should always be preserved to the patient. Usually the adenomatous nodules, however small, are more or less definitely circumscribed and bounded by some sort of connective-tissue capsule; but we have occasionally found widely disseminated adenomatous-like nonencapsulated areas in the otherwise normal thyroid gland of thyreotoxic patients.

On Plate XCI, 1 and 2, are pictured two stages of the operation which we usually perform for the removal of the adenomata. The lower clamp is placed as near as possible to the adenoma in order that the tumor may be made tense by its application. An incision through the glandular tissue between the clamps is made close to the lower one, on the release of which the adenoma partly extrudes itself through and thus defines its enveloping capsule. Before incising between the two clamps figured in the illustration, other clamps are placed on the visible vessels as in the operation for the excision of a lobe, but along higher meridians. By this method both lobes can be freely explored, each by a vertical incision, and the adenomata enucleated. Should a resection-enucleation be indicated the clamps may be transferred to a deeper meridian.

The operation of enucleation was first defined and recommended by Luigi Porta,[281] although probably performed earlier by Heiser and others. It is discussed instructively by Kocher[208] who had a method of his own which is depicted in the several editions of his *Chirurgische Operationslehre*. The operation of enucleation as practised by Socin, who revived it and popularized it, is minutely described by Keser,[184] previously his assistant in Basel.

In the story of the development of the operation for goitre the essential history of surgery is comprised. The problem had been a pressing one for hundreds of years, and not only in countries where the majority of the population was affected with the disease. It could not be solved until surgeons had become proficient in the art of dealing with blood vessels. This art could not be acquired except by experience in operating. The experience could not be gained until anaesthesia was discovered. With the introduction of anaesthesia the number and magnitude of operations promptly increased. The knowledge acquired from the new opportunities soon manifested the need of better methods for controlling haemorrhage, and primitive forms of artery forceps were devised. From these, after a time, the artery clamp was evolved. With the rapidly increasing number of patients and the crowding of hospitals, infection prevailed in forms so dreadful that hospitals had to be destroyed and operating had to be discontinued, only

desperate cases being brought under the knife, for a simple incision was quite surely to be followed by pyaemia, septicaemia, hospital gangrene. With the introduction of Listerism came the daybreak of modern surgery which had dawned with the advent of anaesthesia. And now in the few years since the discovery of anaesthetics, in the brief span of one life, surgery, so it seems, has marched from the beginning to near the end of its great era—the great era of operative development. Fortunate, indeed, are those who have labored throughout this stage of its long journey. More privileged still, we trust, may be the progressive surgeons to come who soon must seek fresh pastures and new friends.

TABLE I.—FRANCE

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
1	Desault, P. J. Giraud, Sur l'extirpation d'une partie considérable de la glande thyroïde. Jour. de chir., Paris, 1792, iii, 3.	F. 27 yrs.	Tumor, 2 inches in diameter, of right side and centre of trachea, extending under sternomastoid. Duration, seven years.	Slight dysphagia. Deformity, for the relief of which the operation was performed.	May, 1791. Excision of right lobe masterfully performed. The superior and inferior thyroid arteries and other vessels ligated as encountered in course of the dissection.	Recovery.	Full account given in our text. Probably the first instance of isolation and ligation of the superior and inferior thyroid arteries in the course of excision of a goitre. *The tumor was carefully separated from the trachea.* The ligation of a "pedicle" or of tissues *en masse* was not resorted to.
2	Bonnet, of Clermont-Ferrand. Brun, Jean, Dissertation sur le goître, Paris, 1815, p. 16.	.....	.....	.....	Date not given. Excision of thyroid gland.	† Death from haemorrhage.	Brun writes: "Bonnet, famous surgeon of Clermont-Ferrand, also practised this operation, but he was not so successful as Dr. Dupuytren; his patient perished, the victim of haemorrhage."
3	Desault, P. J. Rullier, Dict. d. sci. méd., Paris, 1817, xviii, 556.	F.	.....	.....	Date not given. As soon as dissection of tumor was begun blood flowed with such appalling violence that the operator was "obliged to give up the pursuit of his object." He decided to ligate the portion of the thyroid which had been incised, by means of many threads passed into its depths, but spasms supervened and patient died.	† Died on operating table.	*Vid.* text for Rullier's comments.
4	Dupuytren, G. *Ibid.*, p. 557.	F. 28 yrs.	Huge tumor extending from chin to sternum and from one maxillary angle to the other. Duration eight years.	Dyspnoea; dysphagia; flushing face; dazzling; vertigo.	Jan., 1808. Excision of entire gland in relatively bloodless manner. All vessels were doubly ligated before division.	† Died 35 hours post operation from shock.	Full history in our text. Apparently a faultless operation. Interesting to note that Dupuytren always applied the first of the two ligatures on the cerebral side of the artery in order that the second ligature might be tied without causing pain.
5	Operator Unknown. Case communicated to Rullier by "Professor Percy." *Ibid.*, p. 564.	M. Le Marquis de A.	Large sarcomatous goitre.	No symptoms. Deformity.	No details given.	† Death from haemorrhage.	Operation advised by Desault, but disapproved by the eminent Louis and Professor Percy. Rullier comments: "The imprudent operator saw the patient die instantly of a frightful haemorrhage, and this beneath his eyes, between his hands, and under the knife which should have been the instrument for cure."
6	Dupuytren, G. v. Froriep, L. F., Ungeheuer grosse, faserig-zellige Geschwulst an der linken Seite der glandula thyreoidea exstirpirt, mit unglücklichem Ausgange. Notizen aus dem Gebiete der Natur- und Heilkunde, Erfurt, 1831, xxix, 141.	F. 12 yrs.	Tumor, "size of her head, occupying the whole left side of the neck." Duration since infancy.	No mention made of symptoms.	Nov. 22 (1829?). Tumor was found to have broad base; was not pedunculated as had been premised. Pedicle was constricted by three ligatures of thread. These were replaced by a metal ligature after patient was put to bed. Tumor was not removed.	† Died about 40 hours post operation.	Froriep acknowledges his indebtedness to Dr. Clémot, assistant at the operation, for the facts. Haemorrhage from many veins was controlled temporarily by finger pressure. Patient was in syncope at end of operation. Obstinate vomiting set in the day following the operation. Finally, convulsions and death.

TABLE I.—FRANCE.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
7	Nélaton. Goitre, Bull. de la soc. anat. de Paris, 1835, s. 3, i, 100.	M. 20 yrs.	"The tumor was as large as a fist."	No account of symptoms.	No account of operation given.	Not stated.	The specimen was presented to the Soc. anat. "It presented a varied aspect. At certain points it was osseous, in others fibrous, and besides it had the aspect of lymphatic ganglia hypertrophied and indurated."
8	Blandin. Ferrus, Dict. de méd. ou répertoire gén. d. sci. méd., 1836, 2e éd., xiv, 181.	.....	.....	.....	.....	†	Ferrus, after giving an account of Dupuytren's operation, says: "Mr. Blandin had a similar unsuccessful case." There are no further details.
9	Roux. Rufz, De l'extirpation d'un goître. Arch. gén. d. méd., Paris, 1836, s. 2, x, 25.	M. 22 yrs.	Large nodular goitre in center of neck.	.....	March 26, 1835. Total excision of the gland. The goitre was removed in three parts. About 50 ligatures applied. Estimated loss of blood was 1½ pounds. Duration of operation, 70 minutes.	† Died a few hours post operation.	Notwithstanding the great loss of blood, the pallor and collapse of the patient, six ounces of blood were withdrawn from a vein a few hours after the operation. Death followed three hours thereafter.
10	Voisin, P. Chirurgien de la maison centrale de détention de Limoges. Ablation d'une tumeur située dans la région thyroïdienne; guérison. Gaz. méd. de Paris, 1836, s. 2, iv, 372.	F. 36 yrs.	Large tumor of "anterior and inferior part of neck." Duration 21 years.	.....	Oct. 19 (1835?). Excision, probably of left lobe. Six to eight ligatures of veins, three of arteries, all tied with only one knot. Bloody operation. Duration half an hour.	Recovery.	Rather slovenly and rapid operation. Operator states that he was unable to find any trace of a right lobe. Advocates leaving blood in the wound to fill a dead space and to serve in the work of cicatrization. Thus, like John Hunter, he had observed the organization of the bloodclot. Makes interesting comments on the qualities of the blood.
11	Bach. Agrégé médecin en chef-adjoint à l'hôpital civil de Strasbourg. Hirtz, L., Goître volumineux; ligature; guérison. Gaz. méd. de Paris, 1841, s. 2, ix, 9.	M. 30 yrs.	Goitre, right side, "10 cm. in all diameters." Duration 20 years.	Very slight interference with respiration and deglutition. Voice a little raucous.	July 25, 1840. Tumor enucleated, and pedicle ligated; the ligatures being passed through beads and a silver cannula and fastened to a transverse bar in such manner that they could be tightened at pleasure. The bloodless operation was performed in 10 minutes.	Recovery.	The ligature was drawn tighter from time to time, each manœuvre of this kind being followed by increased interference with respiration and swallowing. The tumor sloughed away.
12	*Idem.* Hirtz, L., Goître; ligature; guérison. *Ibid.*	M. 27 yrs.	Cystic goitre, size of an orange, in midline. Slight enlargement of lateral lobes. Duration three years.	Roughened voice; difficult respiration.	1840 (September ?). Draw-knot ligature about thick pedicle. Ligature was gradually tightened and tumor ablated fourth day post operation.	Recovery.	
13	Rigal, R., de Gaillac. Sur le traitement chirurgical du goître par la ligature sous-cutanée. Bull. gén. de thérap., méd. et chir., Paris, 1841, xxi, 224. Case, p. 225.	F. 19 yrs.	Goitre. Size not stated.	Dyspnoea; vertigo; nightmares.	Aug. 8, 1841. Three separate subcutaneous ligatures *en masse*.	Recovery. September 6, 1841, only a trace of the goitre.	"It was decided to apply a ligature *en masse*, but in three distinct parts, and not wishing to sacrifice the skin, we took care to make the ligature subcutaneous."

TABLE I.—FRANCE.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
14	Ballard. Goître volumineux guéri par la ligature sous-cutanée. Original in Bull. soc. de méd. de Bésançon, 1845 (not in Surgeon General's Library). Abst. in Arch. gén. de méd., Paris, 1846, s. 4, xi, 222.	F. 19 yrs.	"Voluminous goitre." Duration eight years.	Dyspnoea; suffocation.	Aug. 8, 1845. Subcutaneous ligatures passed through beads drawn so as to strongly compress the goitre.	Recovery. Infection and "considerable reaction."	Original paper not obtainable. Meagre abstract. Sept. 30, 1845. "The cure was complete."
15	Roux, Ph. J. Petit, Goître. Opération suivie de mort. Bull. soc. anat., Paris, 1848, xxiii, 205.	F. 23 yrs.	Moderately large colloid nodular goitre. Right lobe considerably larger than left. Duration five years.	No symptoms noted.	Nov. 20, 1847. Excision; probably of entire gland. Veins, very large, were ligated and then cut. Some vessels were cut first and tied afterwards; hence, the haemorrhage was probably considerable.	† Died on second day post operation.	The left recurrent nerve was cut.
16	Bégin, Military Hospital, Strasbourg. Tumeur du corps thyroïde. Bull. de l'acad. nat. de méd., Paris, 1849-50, xv, 1110. Case, p. 1111.	M. "Young soldier."	Two cysts, each the size of a pigeon's egg, in midline. The lower tumor plunged behind the sternum.	.....	Date not given. Both tumors were easily removed there being only light adhesions—a fine pedicle connected the two. The cysts contained "serous and cretaceous matter."	"Recovery was difficult and tardy."	While making toilet of wound the thyroid gland was observed to swell remarkably. There was no haemorrhage nor extravasation. The patient, menaced with suffocation and congestion, "was bled copiously."
17	Roux, Ph. J. Observation d'une extirpation de bronchocèle faite avec succès. Bull. de l'acad. nat. de méd., Paris, 1849-50, xv, 1106. (This case is also given by Michel, Obs. II.)	M.	Hard nodular goitre, size of fist, situated probably in the left lobe. Duration 15 years.	.....	July 10, 1850. No anaesthetic. Extirpation "without great loss of blood." Vessels cut and then ligated. Some ligated before being divided. Wound stuffed with wads of lint.	Recovery.	August 31, 1850. Paralysis of recurrent nerve. Tumor consisted of numerous cysts with serous, cretaceous and stony contents. Presumably adenomata.
18	Sédillot, of Strasbourg. Extirpation du goître. Bull. de l'acad. nat. de méd., Paris, 1849-50, xv, 1132.		"Enormous thyroid tumor."	No account of symptoms.	Date not given. Tumor removed. A ligature was placed on the last insertions of the morbid mass.	Recovery.	Tumor "the size of an infant's head." It "hung over the chest." Details of operation not given. Very brief report of this and the two following operations.
19	*Idem.* Bull. de l'acad. nat. de méd., Paris, 1849-50, xv, 1132.		"Enormous thyroid tumor."	No account of symptoms.	Date not given. Tumor removed. A ligature was placed on the last insertions of the morbid mass.	Recovery.	
20	*Idem.* Military hospital. Bull. d. l'acad. nat. de méd., Paris, 1849-50, xv, 1132.		"Enormous thyroid tumor."	No account of symptoms.	Date not given. Tumor removed. A ligature was placed on the last insertions of the morbid mass.	Recovery.	The operator's procedure was "to place successively on these venous plexuses two ligatures, one on the side of the tumor and the other on the opposite side, in order to divide these vessels without haemorrhage."
21	Cabaret (de St. Malo). Extirpation d'un goître. Gaz. méd. de Paris, 1850, s. 3, v, 710. (Presented by Dr. Velpeau. Acad. de méd., séance de Septembre 24, 1850.)	M. 67 yrs.	Goitre, midline, size of an ostrich's egg. Duration about one year.	Shortness of breath on exertion; slightly impeded deglutition; abnormal voice.	May 28, 1850. Sitting posture. Excision of both lobes. Most vessels were cut first, then tied or twisted, but only the central ends. Vessels believed to be the superior thyroid arteries were divided between two ligatures. "Scarcely 500 gm. of blood were lost."	Recovery.	

TABLE I.—FRANCE.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
22	Alquié, Professor. Ligature des artères thyroïdiennes pour remédier à la suffocation causée par le goître. Annales cliniques de Montpellier, 1854, ii, 222. Also reported by Dr. Barbin, Thèse, Montpellier, 1854, p. 26.	F. 25 yrs.	"Enormous goitre, divided into three perfectly distinct lobes." "Careful and repeated examination failed to reveal the inferior thyroid arteries."	"Orthopnoea; difficulty in speaking; disturbance of cerebral circulation; troubled sleep; disturbed digestion; voice peculiar; pulse regular."	Op. I.—April 10, 1854. Ether. Ligation of superior thyroid arteries. Op. II.—Date not given. "Three large arteries were found in contact at the same point, viz., behind the clavicular attachment of the sternomastoid. Unable to make a choice among these enormous vessels, the operator contented himself with ligating an ascending branch of the inferior thyroid artery."	Recovery.	Thirteen days post first operation, circumference of tumor 8 cm. less. Cerebral circulation reestablished. Respiration easy. Sleeps well. Speech normal. "The patient . . . . left, full of gratitude to a surgeon who, had he not been conscientious, might have performed another operation than that of ligating the thyroid arteries, viz., extirpation, to which this woman would readily have consented."
23	Dunglas, in Lima. Observation de goître enkysté. Extirpation du kyste. Guérison. Gaz. méd., Paris, 1856, s. 3, xi, 129.	F. 22 to 24 yrs.	"Goitre, the size of her face." A single cyst. Duration "some years."	.....	1831. Cyst incised and thereupon enucleated. No blood vessels divided and there was "not the least haemorrhage."	Recovery.	Patient complained that her tongue was being torn out when traction was made on the tumor whose only adhesions were "at the base of the larynx." Probably a cyst of the thyreoglossal duct.
24	Chassaignac. Foucart, A., Goître kystique latéral; ablation heureuse par écrasement linéaire. La France méd. et pharmaceutique, Paris, 1860, vii, 284.	F. 29 yrs.	Cystic plunging goitre, size of large pigeon's egg, near the insertion of left sternomastoid. Duration one year.	Constant dyspnoea, frequent cough and occasional dysphagia; severe pains radiating to left shoulder and arm; occasional numbness of arm.	Oct. 17, 1859. Dissected free with scissors, sac accidentally pierced, collapsed completely. Écraseur chain applied to pedicle caused convulsions; reapplication, later, again caused convulsions. Ablation "finally accomplished."	Nov. 22, 1859. Recovery. Rather stormy convalescence.	I saw, last year, a patient with Graves' disease who requested operation on the goitre in order to obtain relief from severe pains in shoulder, arm, forearm, etc. We found a cervical rib. She refused operation on either rib or thyroid when told the cause of her pains.
25	Gosselin, Hôpital Beaujon, Paris. Goître suffocant cancéreux à forme galopante; asphyxie. Tentative infructueuse de trachéotomie. Bull. de la soc. chir., Paris (for the year 1861), 1862, s. 2, ii, 163.	F. 22 yrs.	"The tumor on the right was a continuation of the isthmus consisting of several unequal masses, some of which extended beneath the right sternomastoid. The portion of the tumor on the left was formed of the left lobe of the thyroid, enlarged, but whose structure did not appear to be altered." Duration eight or ten years.	Suffocation; dysphagia.	Exploratory puncture, March 1, 1861. Op. I.—March 2, 1861. Successive subcutaneous sections of the two fasciae of the sternomastoid at its insertion at the clavicle. This was done to relieve suffocation, but had no effect. Op. II.—March 4, 1861. Incision in the midline and on the right and left sides to liberate the tumor. A crucial incision was made on the middle of the tumor which was cauterized with nitrate and "acide de mercure." A quadruple thread was passed transversely through the body of the tumor, as much to produce suppuration as to draw it outside. Op. III.—March 4, 1861. Tracheotomy attempted, but not accomplished.	† Died March 4, 1861. Asphyxia.	Microscopic examination of the tumor and ganglia, made by M. Sée, revealed the existence of cancerous cells.

TABLE I.—FRANCE.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
26	Boeckel. Pesme, A., De l'extirpation du goitre. Thèse, Strasbourg, 1867, p. 43. Obs. I.—Extirpation du lobe gauche de la thyroïde par l'anse coupante de Middeldorpf. Mort.	F. 19 yrs.	Large adenoma of left lobe. Duration eight years.	Dyspnoea.	Op. I.—Oct. 1, 1867. Gland punctured. Op. II.—Oct. 7, 1867. Enucleation. Ligation of left superior and inferior thyroid arteries.	† Died October 10, 1867. Sepsis.	Autopsy: "The wound and parts present a gangrenous aspect." Mediastinal infection.
27	Michel (Professor in Nancy). De l'extirpation complète de la glande thyroïde dans les cas de goîtres suffocants, cystiques ou parenchymateux (opération suivie de succès). Gaz. hebd. de méd. et de chir., Paris, 1873, s. 2, x, 699, 718.	F. 24 yrs.	"Parenchymatous" goitre, involving both lobes, but greatest development in midline and left side. Duration 15 years.	Dysphagia; dyspnoea; muffled voice; headache; giddiness.	Nov. 23, 1872. Excision of entire gland. Operation methodically performed. All arteries tied before division. "Patient had not lost 150 gm. of blood." Time, one hour.	Recovery.	*Vid.* text for abstract of Michel's paper. Goitre operations had been abandoned for 20 years prior to this. He may be said to have revived the operation for France. Michel adopted the novel procedure of permitting vessels doubly ligated to remain undivided until a later stage of the operation.
28	*Idem.* du Terrail Couvat, Ch. Contribution à la thérapeutique chirurgicale de goître cystique. Nouveau procédé opératoire. Thèse, Nancy, 1876, p. 40.	F. 16 yrs.	Cyst of thyroid, size of two fists.	.....	April 28, 1875. A three-act operation: (1) Isolation of greater part of cyst; (2) puncture and evacuation of fluid; (3) cauterization of the sac. Procedure of Michel.	Recovery, but with a slight distention of the neck.	The procedure of Michel is called "Procédé opératoire, procédé mixte (dissection-cautérization)." There were two slight postoperative haemorrhages. Noteworthy, that having excised the entire gland three years previously (case No. 27) he should have resorted to puncture and cauterization.
29	Gross (chef de clin. chir., fac. de méd., Nancy). *Ibid.*, p. 41.	M. 21 yrs.	Cyst, size of large orange, to the left of median line. Duration three years.	Slight respiratory disturbance.	May 31, 1875. Isolation, puncture, cauterization ("dissection-cautérization"). Procedure of Michel.	Recovery.	
30	Michel. *Ibid.*, p. 45.	F.	Cystic tumor, size of fist, pressing on trachea. Duration about two years.	Dyspnoea.	Date not given. Isolation, puncture, cauterization. Procedure of Michel.	Recovery.	
31	Boeckel, Eugène, of Strasbourg. Du goitre rétropharyngien et de son extirpation. Bull. et mém. soc. chir., Paris, 1879, n. s., v, 303.	F. 25 yrs.	Cystic tumor, size of an apple, on right side of neck. A second cystic tumor on the right side was retropharyngeal. Duration about three years.	Dysphagia. Respiration free.	Op. I.—Dec. 7, 1878. "Exploratory puncture." Op. II.—Dec. 9. 1878. Tumor on right side of neck punctured and sac excised; the retropharyngeal cyst accidentally ruptured and removed.	Recovery.	Walls of cyst examined by Recklinghausen, who found them composed of thyroid tissue. Boeckel refers to Storck's three cases of "hématomes rétro-pharyngiens" (Wien. med. Woch., 1878, Nr. 46, 1215) believing them to be the same as his.
32	Péan, Hôpital St. Louis. Brochin, Deux cas d'ablation de tumeurs thyroïdiennes. Case 1.—Goître solide; ablation; abscès des médiastins; péricardite hémorrhagique; mort. Gaz. des hôp., Paris, 1880, liii, 193.	M. 24 yrs.	Solid goitre of right lobe, size of fetus head. Duration 10 years.	Dyspnoea; suffocation.	Oct. 19, 1878. Enucleation. Vessels clamped before division—35 clamps employed; 12 of these were removed the following day. Alcohol dressing.	† Died Nov. 2, 1878.	Oct. 25, 1878. Mediastinal abscess; pericardial effusion; double pleurisy. The tumor was evidently an adenoma. The number of clamps left hanging in the wound is not stated.

TABLE I.—FRANCE.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
33	*Idem.* Brochin, Case 2.—Kyste sanguin du corps thyroïde; ablation de la glande thyroïde, guérison. *Ibid.*, p. 195.	M. 19 yrs.	Tumor, size of large orange, in midline, composed of numerous cysts filled with blood-stained fluid containing cholesterin. Duration five years.	Dysphagia; "sense of constriction of larynx."	July 19, 1879. Enucleation—only five clamps employed, all removed—wound closed with metallic sutures; collodion dressing.	Recovery.	July 20. Alcohol and carbolic dressing. July 26. Small abscess opened. The walls of the tumor were 1 cm. thick.
34	Communicated by Durdos. Boursier, A., L'intervention chirurgicale dans les tumeurs du corps thyroïde. Obs. I.—Kyste colloïde de la glande thyroïde, rupture vasculaire, collection sanguine. Ponction. Guérison. Thèse, Paris, 1880, p. 170.	M. 37 yrs.	Colloid cyst in midline. Circumference of neck 42 cm. Duration 12 years.	Slight dyspnoea; slight dysphagia; pain.	Cyst punctured three times—Aug. 17, 1879, Sept. 15, 1879, and Sept. 19, 1879.	Recovery.	After eight months there was only a small tumor, the size of a pigeon's egg, situated on the median line above the sternal notch. The right lobe of the thyroid is larger than normal.
35	Ollier. Boursier, A., Obs. II.—Goître kystique ayant donné lieu à la triade du goître exophthalmique. Opération par les caustiques. Guérison de tous les symptômes. *Ibid.*, p. 172.	F. 21 yrs.	"Cystic goitre," size of a turkey's egg. Duration three years.	Dyspnoea; palpitation; insomnia; loss of flesh. Pulse 160. Eyes bulging. Menstruation irregular.	June 23, 1877. Incision of tumor, cauterization "pâte Canquoin." July 1. Second cauterization and cyst opened. July 18. Injection with tincture iodine.	Recovery.	Evidently an active adenoma causing severe symptoms of hyperthyroidism. Designated Basedow's disease by Ollier. May, 1879. A little exophthalmus. Pulse 80.
36	Le Fort. Boursier, A., Obs. IV.—Extirpation d'un goître colloïde. *Ibid.*, p. 177.	F. 20 to 24 yrs.	Large colloid goitre; right lobe larger than the left.	No functional disturbance.	April 18, 1877. Excision of right lobe. Division of all vessels between two ligatures. Lister dressing.	"Recovery complete and rapid."	"The whole lobe surrounded by the capsule was easily removed."
37	Trélat. Boursier, A., Obs. VI.—Extirpation d'un goître cancéreux. Mort. *Ibid.*, p. 181.	M. 37 yrs.	Large "cancerous goitre," size of "fetal head at term," occupying the whole right side of the neck. Left lobe normal. Tumor size of hazel-nut for nine years, then very rapid growth during the past year.	Headaches; shooting pains; flushing; vertigo; dazzling; cold sweats; noises in the ears; dyspnoea; voice raucous, bitonal; dysphagia; great loss of weight. Pulse 100.	Feb. 8, 1880. Exploratory puncture negative. Feb. 12, 1880. Excision of the tumor readily accomplished and with little loss of blood. Asphyxia necessitated tracheotomy.	† Died 2½ days post operation.	Autopsy: Besides the tracheotomy wound there was another opening in the trachea on the right. A little fluid in left pleural cavity; great congestion of both lungs.
38	Monod. Monod and Terrillon, Opérations de goître. Obs. I. Bull. et mém. soc. chir., Paris, 1880, n. s., vi, 643.	F. 41 yrs.	Moderately large goitre, chiefly of right lobe. Duration 33 years.	Severe attacks of suffocation; shooting pains; voice feeble and shrill.	Tumor punctured in 1863, 1866, 1880; dark or bloody fluid withdrawn. Oct. 29, 1880. Excision of tumor of right lobe, a small nodule from isthmus, and still another. Considerable bleeding. Lister dressing.	Recovery.	

TABLE I.—FRANCE.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
39	Terrillon. Monod and Terrillon, Obs. II.—Goître. Hypertrophie du lobe droit du corps thyroïde. Dyspnée. Raucité de la voix. Accès de suffocation. Extirpation. Guérison. *Ibid.*, p. 646.	F. 24 yrs.	Goitre, size of two fists, of right lobe. Duration four years.	Dyspnoea; suffocation; raucous voice.	Date not given. Carbolic spray. Excision of right lobe. Division of vessels between catgut and silk ligatures. The isthmus was also divided between two ligatures. Duration 2½ hours.	Recovery.	"I did not hesitate to propose operation to the patient because inspired by the confidence given me by the present means of controlling haemorrhage and by the method of Lister." "The tumor was evidently a very vascular parenchymatous goitre." Probably an adenoma.
40	Boeckel, J. Thyroïdectomie pour un goître suffocant. Guérison par première intention. Mém. soc. de méd., Strasbourg (1879-80), 1881, xvii, 129.	F. 47 yrs.	Plunging goitre of the left lobe of the thyroid gland, measuring 8 cm. longitudinally by 7½ cm. transversely. Duration 10 years.	Attacks of suffocation; cyanosis of lips; face pale; pronounced exophthalmus.	July 20, 1880. Enucleation of tumor. The two thyroid arteries were ligated and divided. Antiseptic precaution. Vapor spray. Lister dressing.	Recovery.	Collar incision. The first mention of the horizontal incision that I have noted (W. S. H.). Anticipated Kocher by many years.
41	Tillaux. Thyroïdectomie pour un goître exophthalmique. Guérison. Bull. acad. de méd., Paris, 1880, s. 2, ix, 401. Reported also by Benard, H. Obs. I.—Thèse, 1882, p. 27.	F. 29 yrs.	Exophthalmic goitre; right lobe the larger. Pathological note: Somewhere in the gland a "cystic sac filled with blackish congested blood" was found. Duration four years.	Marked bruit in vessels of neck; heart enlarged; dyspnoea; suffocation; dysphagia; palpitation; pallor and flushing; melancholy; nervousness; irritability; frequent cutaneous eruptions. "No marked exophthalmus." Pulse 90-100.	Jan. 28, 1880. Chloroform. Pulse 140. L-shaped incision, finally converted into rectangular U. Excision of entire thyroid. Rather irregular and bloody performance, terminating with the ligation on each side of the "pedicle." Deschamps' or Cooper's needles used for most of the 40-odd ligations.	Recovery.	Carbolic spray and Lister dressing employed. Post operation: "Disappearance of ocular troubles, suffocation, and palpitation." March 27, 1880, pulse 80-88. One of the earliest thyroidectomies for Graves' disease. (*Vid.* Ollier's case of adenoma with hyperthyroidism.)
42	Richelot, L. G. Thyroïdectomie. Bull. et mém. soc. chir., Paris, 1881, n. s., vii, 817. Union méd., Paris, 1885, s. 3, xxxix, 193, 205. Case was first published in L'union méd., Paris, 1881, s. 3, xxxii, 997. Communicated by Terrillon.	F. 25 yrs.	Thyroid gland enlarged to one-half size of adult fist. Right lobe larger than left; "middle lobe very hard." Duration 14 years. Induration of isthmus and left lobe due probably to the numerous treatments and infections.	Dyspnoea; dysphagia; "disturbance of cerebral circulation"; voice very weak; metrorrhagia.	Iodine and caustic treatments and punctures at intervals; infections. Sept. 11, 1880. Complete excision of thyroid gland by "curved incision from one carotid to the other." Ligation of the four thyroid arteries. "The operation being finished, catgut ligatures were substituted for most of the silk ligatures." Duration two hours.	Recovery.	Second mention of collar incision (*vid.* J. Boeckel). Immediately post operation complete aphonia. Laryngoscopic examination: Absolute immobility of both vocal cords. After three months some movement of the vocal cords. Four months post operation: Patient speaks without difficulty, voice, though weak, more sonorous than before operation. The operation, well performed, must have been difficult on account of the previous treatments and infections.
43	Lebovicz, of Saloniki. Extirpation des goîtres. Case I.—Sarcome kystique du corps thyroïde; extirpation; guérison. Gaz. hebd., Paris, 1881, s. 2, xviii, 740.	F. 42 yrs.	"Tumor, size of man's fist, on right side of neck." Duration 17 years.	Dyspnoea; dysphagia.	Nov. 21, 1880. Incision and evacuation of cyst. Contents purulent. Wall of sac excised. Sternomastoid divided.	Recovery.	"Rigorously applied antiseptic treatment." Very brief report.

TABLE I.—FRANCE.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
44	*Idem.* Case II. — Enchondrome du corps thyroïde; extirpation; mort au 6me jour.	M. 46 yrs.	"Enormous tumor of front of neck." Duration 26 years. Rapid growth in last two years.	Voice raucous; headache; deafness; face pale; suffocation.	Date not given. "Extirpation." No details—apparently a simple operation; only small vessels encountered.	† Died on the sixth day.	Tumor found to be multilocular. Death sudden, "without apparent cause." Brief report. Autopsy not permitted by the Turks.
45	Périer. Extirpation du corps thyroïde. Guérison. Bull. et mém. soc. chir., Paris, 1881, n. s., vii, 564.	M. 23 yrs.	"Hard tumor of right lobe and isthmus, size of an orange." Duration 13 years.	"Neither pulsation nor bruit" in tumor. No mention of symptoms.	May 27, 1880. Antiseptic precautions. Excision of tumor (isthmus and right lobe). Time 50 minutes. The left lobe appeared to be normal and was not removed.	Recovery.	"The tumor weighed 130 gm., and had the size and form of a breast and also its consistency, except for some disseminated calcified nuclei." Probably an adenoma. Brief report.
46	Bouilly. Goître hypertrophique simple. Thyroïdectomie; médiastinite aiguë infectieuse; mort rapide. Bull. et mém. soc. chir., Paris, 1882, n. s., viii, 293.	F. 23 yrs.	Ovoid tumor covering the trachea from the larynx to sternum, size of an orange. Duration about five years.	Painful prickling in tumor; dyspnoea; attacks of suffocation. "Neither bruit, pulsation nor exophthalmus."	Oct. 22, 1881. U-incision. Extirpation of tumor weighing 145 gm. "Finally, the lateral pedicles were cut between two strong catgut ligatures."	† Died Oct. 25, 1881. Acute infection of mediastinum.	Histologically the tumor "is constituted by simple hypertrophy and proliferation of the vesicules of the gland without predominance of any normal or pathological element."
47	Tillaux, Chirurgien de l'Hôpital Beaujon. Benard, H., Contribution à l'étude du goître exophthalmique. Thèse, Paris, 1882. Obs. II.—Sarcome du corps thyroïde ayant donné lieu à tous les symptômes du goître exophthalmique. Ablation de la tumeur. Guérison de tous les accidents. p. 36.	M. 33 yrs.	"Rounded tumor" of left lobe, which at operation was found to extend below the sternum. Thyroid cartilage displaced to right. Duration one year.	Suffocation; palpitation; dysphagia; raucous cough; sclera visible around cornea; sense of tension in eyes; diplopia for distant objects. Patient very irritable and easily agitated. No bruit in tumor. Pulse 80, but easily accelerated.	May 18, 1881. Chloroform anaesthesia begun, but patient became so cyanosed that operation was not undertaken. May 21, 1881. Operation under large doses of chloral and subcutaneous injections of morphia. Lister technique. Rectangular U-shaped incision, cutaneous flap dissected with the fingers. Tumor ruptured in course of operation and friable, granular masses escaped, leaving little but the capsule for removal. Right lobe and isthmus "unaltered." At bottom of cul-de-sac in mediastinum the left innominate vein "of enormous size was plainly visible."	Recovery. July ?, 1881. Exophthalmus and all the other symptoms of hyperthyroidism had vanished. Died about two months post operation. No post-mortem note.	Diagnosis before operation: "Exophthalmic goître as plain as possible." Post-operation note: "Lungs probably seat of generalized cancer, from which patient will soon succumb." "Tumor found on careful histologic examination to be sarcoma." As the toxic symptoms could not have been caused by a sarcoma or relieved by its removal, we may assume either that the tumor was an adenoma or possibly carcinoma, or that the gland was hyperplastic and in part, at least, removed.
48	Tillaux. Goître kystique volumineux; ablation; guérison. Bull. acad. de méd., Paris, 1882, s. 2, xi, 1445.	M. 25 yrs.	"Cystic goitre, size of small ostrich egg, occupying the whole extent of the neck and plunging into the mediastinum." The tumor was "very hard, almost osseous at some points. . . . fibrocartilaginous at others." Thyroid cartilage dislocated 3 cm. to left. Greatest circumference is 46 cm. Duration eight years.	Voice slightly roughened.	1874. Received, in Holland, interstitial iodine injections. Oct. 25, 1882. Lister technique. Excision. Rectangular U-shaped incision. Omohyoid, sternohyoid and sternothyroid muscles divided. "As soon as the tumor was extracted a multitude of forceps were applied to the arteries showing on all sides." Pedicle over trachea ligated *en masse* with catgut.	Recovery.	Quite bloody operation. Vessels clamped as encountered. No attempt to secure the thyroid arteries as preliminary step. The entire gland was probably excised.

TABLE I.—FRANCE.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
49	Boeckel, J. Thyroïdectomies. Fragments de chirurgie antiseptique, Paris, 1882, 468. Obs. p. 471. Thyroidectomie partielle pour un goître du volume de deux poings. Lister. Guérison par première intention au bout de neuf jours.	F. 20 yrs.	Cystic colloidal goître of right lobe. Circumference of neck 47 cm. Duration six years.	Suffocation for two months.	Sept. 16, 1880. Cyst punctured; extirpation of right lobe after ligature and division of the two thyroid arteries.	Recovery.	
50	*Idem.* Obs., p. 472.	F. 21 yrs.	"Cystic goitre, right side. Circumference of neck 40 cm., tumor is median." Duration six months.	.....	Date not given. Injections of iodine and evacuation of liquid. Aug. 26, 1880. Evacuation of cyst and extirpation of sac. Lister dressing.	Recovery.	
51	Beauregard, of Havre. Delens, Observation de thyroïdectomie. Bull. et mém. soc. chir., Paris, 1883, n. s., ix, 21.	M. 28 yrs.	"Three-lobed tumor about the size of an orange; central lobe the largest." Duration 14 years; rapid growth of late.	Suffocation; raucous voice, at times complete aphonia.	Sept. 5, 1882. After "isolation" of both lobes "the pedicle was so large and short that it prevented dissection and ligature of the thyroid arteries." Hence the tumor was transfixed by crossed steel rods and ligated under these by a rubber tube. Sept. 9. Severe haemorrhage; thereupon the rubber tube was replaced by a chain écraseur and the tumor removed.	Recovery.	"The tumor weighed 285 gm. The walls of the sac were thick, but pliable. The remains of the thyroid body were studded with numerous calcareous concretions." Authors, at this time, did not recognize adenomata as something to be distinguished from colloid goitre.
52	Pozzi, S., service of Professor Verneuil, Hôpital la Pitié, Paris. Goître plongeant parenchymateux et kystique. Extirpation après trachéotomie préliminaire. Forcipressure prolongée de l'artère thyroïdienne supérieure. Hémorrhagies secondaires. Mort. Gaz. méd. de Paris, 1883, s. 6, v, 510.	M. 17 yrs.	"Trilobed tumor occupying whole right side and center of neck, extending to left." Duration five years.	Modified voice; dyspnoea; wheezing; suffocation attacks.	July 1 and 8, 1883. Tumor punctured by Verneuil. Aug. 1. Drainage tube "in the sac." (Verneuil.) Oct. 5, 1883. Operation by Pozzi. Chloroform. Tracheotomy to relieve asphyxia. Excision of both lobes. Operation difficult on account of the previous surgical treatment. Duration three hours. Evidently considerable haemorrhage. Two forceps on large vessel, accidentally wounded, were left in wound because ligation was found impossible.	† Died Oct. 8 about 10 a. m., 3 days post operation. Haemorrhage.	Oct. 7. Severe haemorrhage on removal of forceps was controlled by reapplication of several forceps. Oct. 8, 4 a. m. "Enormous loss of blood; haemorrhage controlled with difficulty, with about 10 forceps. Patient almost exsanguinated." Autopsy: The right superior thyroid artery found cut 7 mm. from its origin. "There was no clot in the artery. The right external carotid had apparently been caught in one of the last forceps."
53	Labbé, Léon. Kyste suppuré du corps thyroïde.—Accès de suffocation. Thyréoïdectomie. Guérison. Ann. d. maladies de l'oreille, du larynx et des organes connexes, Paris, 1883, ix, 146.	F. 28 yrs.	Firm, elastic, ovoid tumor, the size of a large egg, ending just above suprasternal hollow and lifting up the edge of the right sternomastoid. Duration nine months.	Dyspnoea; dysphagia.	June 6, 1882. U-shaped incision, the branches measuring 7 cm. and 6 cm. across. The right incision followed the sternomastoid, and the left was a little beyond the midline. The tumor was isolated and enucleated. The cyst wall was ruptured, "nevertheless the extirpation of the sac could be entirely carried out." "The loss of blood was insignificant; there were few ligatures." Carbolic spray during whole operation. Lister dressing.	Recovery.	Post operation: "The wound preserved good aspect, with only a few drops of sero-purulent liquid from the drain."

TABLE II.—ITALY

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
1	Marzuttini, G. B. Gozzo enorme; inflammazione, suppurazione, cancrena. Settone. Ligatura della tiroidea superiore. Bull. delle sci. med., Bologna, 1846, s. 3, ix, 365. Originally published in Mem. delle med. contemporanea, xiv, 337.	F. Past middle age.	Enormous goitre "reaching to the hyoid bone, and laterally to the trapezius." The tumor covered the right breast and had an abscess at its extremity. Duration "since childhood."	Dyspnoea; vertigo.	Oct. 6, 1844. Ligation of the superior thyroid artery. "Haemorrhage arising from certain arteries was soon controlled by ligature."	Recovery. Oct. 21, 1844. "Tumor" reduced one-half.	"The patient was seen not long before the publication of the paper, and she was in better health than before the ligation of the artery." Infection may, in part, have been responsible for the ultimate result. There was a large suppurating cavity within the tumor. For other low hanging goitres *vid.* Holmes (Great Britain, No. 23) and Perassi (Italy, No. 19).
2	Porta, Luigi, professore di clinica chirurgica in Pavia. Delle malattie e delle operazioni della ghiandola tiroidea, Milano, 1849, p. 135.	F. 26 yrs.	"Large hypertrophied tumor of the right lobe."	.....	April, 1835. Ligation of the right superior thyroid artery.	Recovery. Tumor not affected by the operation.	"The operation, ... in spite of some difficulty in discovering the artery hidden behind the summit of the swollen lobe, succeeded without accident *per se.*"
3	*Idem.* P. 135.	M. 28 yrs.	"Large hypertrophied tumor of the right lobe."	.....	Nov. 30, 1846. Ligation of the right superior thyroid artery.	Recovery. Tumor not affected by the operation.	Patient died from erysipelas of the head three months after the healing of the wound. The lumen of the ligated artery was found to be normal below the ligature.
4	*Idem.* Obs. XI, p. 136.	M. 20 yrs.	Large goitre consisting of three lobes, the median as large as a turkey's egg, those on the sides each larger than a fist. Duration "from childhood."	Dyspnoea.	May 9, 1848. Ligation of both superior thyroid arteries: the right, palpable, was tied in a "few minutes; the left, deep seated, in 15 minutes." Short vertical incisions.	Recovery. The tumor was diminished by one-third of original volume and remained so for four months when it "seemed disposed to grow again."	
5	*Idem.* P. 139.	M. 38 yrs.	"Very voluminous goitre."	Suffocation.	Dec., 1848. Venesection, without relief. Ligation of what was thought to be the enlarged inferior thyroid artery.	† Died on the day of operation.	"At autopsy it was noted with surprise that the ligature had been placed on the internal carotid artery." Cause of death not stated.
6	*Idem.* Obs. XII, p. 149.	M. 20 yrs.	"The tumor of the right thyroid lobe not larger than an orange." Duration "from childhood." "The left lobe appeared small and atrophied."	Altered voice; dysphagia; dyspnoea; fatigue; cough; oppression in the chest.	Iodide pomade tried without effect. 1840. Tumor incised, "a coriaceous cyst as large as a turkey's egg was discovered, isolated and drawn out. Then were disinterred and extracted, two sarcomata of smaller size." Duration of operation one-quarter of an hour with loss of four or five ounces of blood and without the denudation of any adjacent organ except an anterior branch of the superior thyroid which was cut and twisted.	Recovery.	"After one month of suppuration the wound healed with total disappearance of the tumor and of the symptoms." Operator saw patient in 1848, eight years post operation. He was relieved of all symptoms and there remained no trace of the goitre.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
7	*Idem.* Obs. XIII, p. 150.	F. 25 yrs.	"Tumor, as large as a hen's egg, on the left side of the neck."	.....	Iodine tried without effect. Aug. 3, 1842. Ligation of the extremity of the trunk of the superior thyroid artery. Incision of tumor and excision of all the central "carne" in pieces.	Recovery.	Open wound. Phlegmon of neck and pulmonary disturbances. Venesection, purgatives, etc. All symptoms disappeared in two weeks. Wound healed in a month.
8	*Idem.* Obs. XIV, p. 151.	M. 9 yrs.	Tumor, the size of a hen's egg, "protruding at the summit of the right lobe of the thyroid gland beside the larynx."	.....	1843. The tumor, easily enucleated, was found to be a "sarcoma" the size of a "nut."	Recovery.	The "cortex" was divided to a depth of a millimetre. Thereupon the tumor was exposed.
9	*Idem.* Obs. XV, p. 152.	F. 16 yrs.	Goitre on the right side of the neck, size of a fist, "which pressed close to the lower jaw."	.....	Pomade of iodide and burnt sponge had been tried without effect. 1844. After torsion of an anterior branch of the superior thyroid artery, the tumor was split, exposing to view a circumscribed sarcoma the size of a hen's egg. This being enunciated, "the empty cortex collapsed." Loss of blood amounted to a few ounces.	Recovery.	Post-operation symptoms: Phlegmon of the neck; dysphagia and pain in the chest; headache; restlessness; fever. Treatment: "Six generous bleedings of the arm, 40 leeches at the temple, repeated purgatives, and most severe diet. After these measures the symptoms in the head, neck and chest disappeared and the wound, after copious suppuration, healed at the end of five weeks."
10	*Idem.* Obs. XVI, p. 153.	M. 24 yrs.	Tumor, the size of a lemon, in the left lobe.	Dyspnoea; attacks of suffocation.	Iodine and burnt sponge had been tried without effect. 1845. Incision of tumor exposed a large coriaceous cyst which was excised except at the base, where the capsule was adherent to parts in the mediastinal region. Torsion was applied to a wounded artery.	Recovery.	"Inflammation in the wound was dissipated by two bleedings and 20 leeches. After copious suppuration the cavity was reduced to a fistula which closed in about two months."
11	*Idem.* Obs. XVII, p. 154.	M. 27 yrs.	Goitre, the size of a fist, in the right lobe, extending to the manubrium.	Mental anxiety; dyspnoea; dry cough.	1846. "Extraction of two sarcomata the size of a "nut"; a cartilaginous cyst full of limpid serum was excised." Duration of operation "15 minutes without wounding vessels and without haemorrhage."	Recovery.	Post-operation symptoms: Fever, with swelling of the neck; difficulty in breathing; congestion of the head; somnolence. Treatment: "Five generous bleedings of the arm and in a week all the symptoms disappeared and the wound, after abundant suppuration, was reduced to a small fistula, which was still open when the patient left the hospital."

TABLE II.—ITALY—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
12	Rizzoli, Prof. F., chir. primario nello Spedale Maggiore di Bologna. Gozzo sottosternale de tessuto erettile operato colla legatura del tumore. Collezione delle memorie chirurgiche ed ostetriche, Bologna, 1869, i, 112. Originally published by Rasi in Bull. delle scienze med. di Bologna, 1845, s. 3ª, vii, 237.	F. 27 yrs.	Rapidly growing, partly subclavicular, tumor. Diagnosed "Walther's aneurismatic goitre" because of "thrill and peculiar pulsation."	Attacks of suffocation; dyspnoea; dysphagia.	1833. Ligation of the pedicle of the tumor. The ligature on subsequent occasions was drawn tighter.	Recovery.	"The tumor came away in the hands of the operator on the eighth day. A sudden spurt of blood was controlled by filling up the wound with lint and by light compression with the hand."
13	Porta, Luigi prof. di clinica chirurgica in Pavia. Della legatura delle arterie tiroidee per la cura del bronchocele. Annali universali di medicina, Milano, 1850, cxxxvi, 5.	F. 17 yrs.	Goitre on the left side of the neck the size of a mandarin. Duration from childhood.	Dyspnoea; dysphagia.	July 28, 1850. Ligation of left inferior thyroid artery. Ligation of left superior thyroid artery. Duration of operation three-quarters of an hour.	Recovery. "Good health, no trace of the tumor."	First case of ligation of the inferior thyroid artery.
14	Bella, F. Storia di una cisti tiroidea felicemente guarita. Il morgagni, Napoli, 1876, xviii, 258.	F.	Cystic tumor of isthmus larger than a mandarin. Duration seven years.	.....	1875. Puncture of cyst. Iodine injections. Vertical incision about one month later. "The walls of the cyst were attached to the skin on each side by two sutures. Between the sutures the sac was incised. From the cyst came turbid liquid and granular matter." "Drainage tube for the first few days, and frequent injections of tincture of iodine and carbolic solution."	Recovery. "Some months after the discharge of patient there was no return of the tumor."	Post operation: "The cavity grew smaller day by day, and at the same time a small tumor appeared around the aperture. After two months there was only a fistulous opening terminating in the little tumor. Treatment with nitrate of silver soon closed this fistula."
15	Menzel, A., medico chirurgo primario, Ospitale Civico, Trieste. Struma cistica; estirpazione, guarigione. Resoconto sanitario dell'Ospitale Civico di Trieste per l'anno 1873, Trieste, 1876, ii, parte speciale, p. 93.	F. 18 yrs.	Cystic goitre, the size of a hen's egg. Duration two years.	.....	Aug. 11, 1873. Extirpation. Haemorrhage during operation was slight, but some hours post operation a more severe haemorrhage supervened, probably on account of the slipping of a ligature.	Recovery.	The patient was a cretin. Very brief account of case.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
16	Bottini, E., of Pavia. Estirpazione totale di gozzo parenchimatoso. Guarigione. Gior. della R. accad. di med. di Torino, 1878, s. 3, xxiii, 353. Obs. I, p. 365. (Read before the Accademia March. 15, 1878.)	F. 28 yrs.	Parenchymatous goitre, the size of an infant's head, in the centre of the neck. Duration from childhood.	Attacks of suffocation; voice low and thick; speech difficult; "respiration gasping with whistling."	Sept., 1868. Spedale Maggiore of Milan. Professor Albertini attempted extirpation, but had to desist on account of severe haemorrhage (according to the story of the patient). Severe suppuration lasted for months. His second attempt to operate was futile on account of haemorrhage. Jan. 22, 1877. Dr. Bottini. "The central part of the morbid mass was ligated and the mass removed." Duration of operation 30 minutes. Fifty-two ligatures were applied, without wounding a single vein or artery. Lister methods scrupulously adhered to.	Recovery.	"Twenty-five ligature threads, gathered together at the lower angle of the wound, came away little by little." Zambianchi, in 1873, refers to this case of Bottini's as the first total extirpation of goitre in Italian surgery. Perassi, at the meeting of the Accademia of April 5, 1878, refers to this communication of Bottini's, and gives a case of his own of removal of a very large "bronco-lipo-cele," which he accomplished in 1864. It does not seem quite clear that this was a total extirpation. First goitre case in which Listerism was employed in Italy. All vessels divided between two ligatures.
17	*Idem.* Obs. II, p. 371. Case given in greater detail in Gior. della R. accad. di med., Torino, 1878, s. 3, xxiv, 179. Altro caso di estirpazione completa di gozzo parenchimatoso. Guarigione.	M. 40 yrs.	Large parenchymatous goitre on the right side of the neck. Duration about two years.	.....	March 19, 1878. "Procedure the same as in the preceding case. Fifty-four ligatures were applied. While, on account of ligating the vessels before dividing, there was no spurt of arterial blood, there was enough blood lost to give the operator uneasiness at times.	Recovery.	Probably an excision of isthmus and right lobe.
18	*Idem.* Gior. della R. accad. di med., Torino, 1878, s. 3, xxiv, 170. Obs., p. 185. More fully described by Baiardi, Tansini and Brichetti. Gozzo cistico. Asportazione totale. Guarigione. L'osservatore gazz. delle cliniche di Torino, 1880, xvi, 131.	F. 18 yrs.	Cystic goitre, the size of a large mandarin, extending from one sternomastoid to the other, divided into two lobes, the right a little larger than the left. Duration four years.	Dyspnoea.	1878. Total extirpation. "The operation was difficult, for in spite of proceeding with the greatest caution and always dividing the tissues between two ligatures, haemorrhage was severe." Forty-eight ligatures were applied.	Recovery.	Vertical incision. Tracheal "pedicle" of goitre surrounded by catgut ligature; ablation beyond ligature. This is probably the first total extirpation for Italy.
19	Perassi. Gozzo voluminoso esportato con successo mediante il taglio e la legatura. Gior. della R. accad. di med., Torino, 1878, s. 3, xxiii, 389. (Read at the meeting of April 5, 1878.)	M. 46 yrs.	An enormous goitre, "bronco-lipo-cele," which hung over the breast down to the abdomen. Duration 15 years.	.....	Aug. 18, 1864. Operation without anaesthesia. The tumor was first punctured. The attempt to excise it had to be abandoned. Seven ligatures were passed through the pedicle; the tumor was then ablated.	Recovery.	The goitre in Marzuttini's case (No. 1) also hung down over the breast. In Timothy Holmes's case (Great Britain, No. 23) the cyst hung below the patient's waist.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
20	Bottini, E. Tansini, Iginio, Estirpazione totale di gozzo retrosternale, eseguita con successo nella clinica operativa della R. universita di Pavia. Gazz, med. italiana, Lombardia, 1879, xxxix, 481.	M. 31 yrs.	Substernal goitre, the size of a small mandarin. Duration 22 years.	Dyspnoea.	Nov. 10 (year?). Total enucleation of a tumor of the isthmus—partly substernal.	Recovery.	Bottini uses catgut for the peripheral ligatures; silk for the central. Strict antiseptic precautions.
21	Dionisio, F. Estirpazione di gozzo. Guarigione. L'osservatore. Gazz. delle cliniche, Torino, 1879, xv, 433.	F. 25 yrs.	Spherical tumor of isthmus, size of a fist. Duration about four years.	Dyspnoea on exertion; suffocation from the slightest pressure on the tumor; dysphagia.	April 21, 1879. Tumor incised and emptied of its contents. Severe haemorrhage from the cavity was controlled by ligature of some small arteries and by compression sponges. The anterior portion of the sac was removed with scissors and the edges of the remaining portion were sutured to the margin of the skin-wound.	Recovery.	Operation similar to the eventration which Kocher performed upon intrathoracic goitres too large for delivery, but without justification in this case.
22	Berruti, L., Spedale Mauriziano di Torino. Grosso gozzo vascolare guarito colla legatura elastica. Gior. della R. accad. di med. do Torino, 1879, s. 3, xxvi, 140.	M. 49 yrs.	Large pendulous, cylindrical tumor of the neck, which covered part of the sternum. Duration 30 years. "After two years of growth a second tumor appeared on the first. The first tumor was hard, but the second was soft."	Haemorrhage from the tumor, necessitating surgical interference.	May 13, 1879. The pendulous tumor, skin included, was firmly ligated with an elastic cord. The skin was thrown into radiating folds by the ligature. May 18. The sloughing tumor was ablated 3 cm. from the ligature. Immediately a considerable haemorrhage occurred; a second encircling ligature was applied.	Recovery.	This performance resembles the proceeding of Matthias Mayor (1826).
23	Albertini, Professor, Ospitale Maggiore, Milan. Esportazione di gozzo. Gazz, degli ospitali, Milano, 1880, i, 476.	F. 57 yrs.	Large goitre. Duration eight years.	.....	Date not given. Extirpation. Twenty-two ligatures were applied. Very slight haemorrhage. Scrupulous antisepsis. Duration 32 minutes.	Recovery.	Very brief notes. Unable to state the nature of the operation.
24	Bottini, E. Baiardi, Tansini and Brichetti, Ipertrofia del lobo medio. Estirpazione. Guarigione. L'osservatore. Gazz. delle cliniche di Torino, 1880, xvi, 117.	F. 12 yrs.	Tumor, the size of a nut, immediately over the larynx. Duration one year.	.....	1877. Enucleation of tumor; ligation of pedicle.	Recovery.	
25	Bruno, L., and Novaro, in Turin. Canalis, Gozzo ipertrofico del lobo destro del corpo tiroide, con cisti a contenuto colloide. Estirpazione. Guarigione. *Ibid.*, p. 625.	M. 10 yrs.	Tumor, the size of a hen's egg, on the confines of right lobe and isthmus.	.....	Aug. 17, 1880. Exploratory puncture. Aug. 31, 1880. Enucleation; pedicle doubly ligated with catgut and the tumor ablated. Lister dressing.	Recovery.	Devecchi (*l. c.*) asserts that this operation was performed by Novaro, and that Bruno made only the exploratory puncture.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
26	Ruggi, G., Ospedale Maggiore di Bologna. Folier, C. A., Gozzo follicolare con parziale degenerazione cistica curato coll' estirpazione della glandola tiroidea. Guarigione. Bull. delle scienze mediche, Bologna, 1880, s. 6, vi, 388.	F. 19 yrs.	"Tumor on the anterior and centre of neck, the size of a fetus head at five months." Duration 13 years.	.....	June 29, 1880. Precise nature of operation not clear. Partial enucleation and transfixion; ligation of pedicle over trachea in parts; ablation. Rupture of a cyst in course of the operation.	Recovery.	Vertical incision. Péan and Billroth forceps left hanging in wound for three or four days.
27	Medini, L. Storia di una voluminosa cisti multiloculare della tiroide guarita colla spaccatura. *Ibid.*, p. 263.	F. 67 yrs.	Tumor, the size of an adult's head, reaching from the lower jaw to the sternum and on the right and left to the anterior border of the trapezius. Duration about 41 years. Skin over tumor shiny, tense and livid.	Cyanosis; breathing stertorous; suffocation; alteration in the voice; cerebral symptoms.	The patient had been bled at the temple for cerebral symptoms with only temporary relief. 1880. Tumor incised, evacuation of about 900 gm. of colloid substance.	Recovery.	Explored with the finger, the tumor proved to be a cyst lined with calcareous plaques.
28	Bottini, E. Tansini, I. Sulla metodica estirpazione del gozzo. Gior. della R. accad. di medicina di Torino, 1880, s. 3, xxviii, 81. Obs. I, p. 84. Estirpazione di enorme gozzo parenchimatoso. Insuccesso.	M. 43 yrs.	Tumor in front and sides, size of the head of the patient. The surface of the tumor is nodular and overrun by large and numerous veins. Duration 24 years.	Dyspnoea.	Feb. 14, 1880. Curved incision from the right mastoid process to the left sternomastoid. It was proposed to attack the tumor on the left. Although blunt dissection was used there was severe haemorrhage. Controlling the haemorrhage with difficulty, operator attempted to detach the tumor between double ligatures, but this did not succeed. Then the operator attacked it from above, proceeding now to the right and now to the left, and "thanks to about 200 ligatures," succeeded in removing the tumor.	† Died March 5, 1880, from sepsis.	Oblique collar incision. At autopsy two aberrant lobes were found behind the sternum and a lobe, probably aberrant, in the neck. These cases are often excessively vascular—some have been almost inoperable. I presume that this case was a very difficult one for the period, and that the operation was creditably performed by this masterful surgeon.
29	*Idem.* Obs. II, p. 88. Estirpazione completa di gozzo parenchimatoso retrosternale. Guarigione.	M. 19 yrs.	"Tumor in the lower part of the right carotid region, the size of a hen's egg." Duration one month.	.....	May 3, 1880. Enucleation.	Recovery.	The tumor contained a large cystic cavity filled with brownish blood. Microscopic examination showed fetal type of thyroid gland. This is the first mention that I have found of this type of tumor—Wölfler's classic monograph on tumors of the thyroid gland appeared the same year.
30	*Idem.* Obs. III, p. 90. Estirpazione completa di gozzo prevalentemente vascolare. Guarigione.	F. 60 yrs.	"In the lower two-thirds of the neck are two tumors, each the size of a mandarin, divided in the midline by a furrow." Duration a few months.	Dyspnoea.	May 3, 1880. Local anaesthesia. Enucleation of the tumors which were very vascular.	Recovery.	First mention of local anaesthesia. Bottini used a blunt instrument in placing the ligatures—after the manner of v. Bruns and others of his day. He was evidently well supplied with artery clamps.

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
31	*Idem.* Sulla metodica estirpazione del gozzo. Gior. internazionale delle scienze mediche, Napoli, 1881, iii, 139. Obs., p. 143.	F. 70 yrs.	Trachea compressed by an enormous goitre.	.....	Date not given. Extirpation. The operation required 150 ligatures.	Recovery.	Bottini devotes only three lines to the report of this case, of which we find no mention elsewhere.
32	Colomiatti, Prof. V., Hospital of San Luigi, Turin. Devecchi, P., Contributions to the radical cure of goitre. The San Francisco Western Lancet, 1881, x, 241. Obs., p. 245.	M. 60 yrs.	Circumscribed tumor of the right lobe, extending back of the sternum. Duration from childhood.	Pain; dyspnoea. Ulcer; erysipelas.	May, 1879. "Total extirpation" of the right lobe. Posterior surface of sternum denuded in course of operation.	† Died from pleuritis in a few days. Mediastinal infection.	Colomiatti was assisted by Devecchi, and on the death of the patient remarked to him that if he should meet with an identical case he would trephine the sternum and introduce a drainage tube for the free flow of the secretions.
33	Fiorani, G., chir.-prim. operatore all' Ospedale Maggiore di Lodi . L'esportazione del gozzo per mezzo del laccio elastico. Gazz. degli ospitali, Milano, 1881, ii, 241. Obs. I, p. 243. Gozzo di mediocre volume. Esportazione. Guarigione.	F. 19 yrs.	"Tumor, the size of an orange, situated to the right of the larynx." Duration nine years.	.....	May 16, 1880. Tumor partly enucleated and pedicle ligated. Antiseptic precautions were observed. Large vessels encountered were divided between two ligatures. Duration of operation "a few minutes."	Recovery.	May 21, 1880. "The greater part of the completely mortified tumor excised." May 31, 1880. "The ligature fell away and with it the pedicle."
34	*Idem.* Obs. II, p. 244. Gozzo molto voluminoso. Esportazione. Morte.	F. 25 yrs.	Tumor occupying the anterior part and both sides of the neck. Duration about two years.	Dyspnoea. Goitre interferes with the movement of the neck.	Oct. 17, 1880. Tumor partly enucleated and pedicle ligated. "Antiseptic precautions scrupulously observed." Duration of operation 13 minutes.	† Died Nov. 7, 1880. "Typhoid fever." Death probably due to sepsis.	"The tumor was removed with scissors on the fourth day; erysipelas on the fifth day; the ligature came away on the 12th day. Aphonia was present after operation." Probably a left-sided lobectomy.
35	*Idem.* Obs. III, p. 247. Gozzo retrotracheale. Esportazione.	M. 13 yrs.	Hard goitre, the size of a large nut, firmly fixed to the right side of the trachea. Another tumor was palpated behind the trachea, a little to the left, the size of a large nut.	Labored breathing; feeling of suffocation at night.	Jan. 14, 1881. Tumor behind the trachea was partly enucleated and pedicle ligated.	Recovery.	"Three days after the operation the goitre was smaller. The ligature fell away on the 14th day."
36	Giommi, M. Estirpazione totale di gozzo follicolare-colloide, prima curato colle iniezioni parenchimatose di iodio. Raccoglitore medico, Forli, 1881, s. 4, xv, 13. Case, p. 14.	F. 40 yrs.	Very large globular goitre occupies the whole front of the neck and extends behind the manubrium. Duration many years.	The patient "has pellagra." Dizziness; noises in the ears; dyspnoea.	May 22, 1879. No anaesthetic. Longitudinal incision. Ligation of the short, thick pedicle. Haemorrhage from two openings in the hardened capsule of the goitre. Tightening the ligature did not control the haemorrhage. The margins of the openings were sutured and encompassed with a figure of eight ligature. The haemorrhage controlled, a metal thread was placed below the silk ligature, and the tightening begun. Bleeding occurred again, but a few twists of the vise controlled it.	Recovery.	May 23. Tumor ablated in front of the metal ligature which came away on the third day.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
37	Novaro, G. F. Esportazione del lobo destro della tiroide; resezione della faringe; autoplastia delle faringe; morte per emorragia secondaria all'undicesimo giorno. Gior. della R. accad. di med. di Torino, 1881, s. 3, xxix, 34.	M.	Epithelioma of right thyroid lobe, secondary to cancer of larynx. Duration a few weeks.	.....	Jan. 10, 1881. Vertical incision. Removal of the tumor with the resection of the right wall of the pharynx. The opening in the pharynx was closed with a layer of skin. The ligature of the superior thyroid artery was displaced and violent haemorrhage occurred. Catgut ligatures were used.	† Died Jan. 25, 1881, suddenly from haemorrhage. Infection.	Aug. 19, 1880. Novaro extirpated the whole larynx for epithelioma. The enlargement of the right thyroid lobe was evidently a recurrence of the neoplasm.
38	Piccinelli, E. Contributo all'esportazione del gozzo coll'allacciatura elastica. Guglielmo la Saliceto. Gior. di med., farmacia e sci. affini, Piancenza, 1881-82, anno iii, 229.	F. About 19 yrs.	Spherical, midline goitre, the size of two mandarins, furrowed transversely by three lines and having the appearance of three lobes. Diagnosis: "Vascular and aneurismatic bronchocele." Duration seven years.	For a year or more the voice has been harsh and hoarse. Attacks of dyspnoea and dysphagia.	Jan. 26 (year?). In isolating the tumor embarrassing haemorrhage occurred. As the tumor had no real pedicle, a double elastic ligature was thrown around it to control the haemorrhage. Haemorrhage continued, and was controlled by "piazza haemostassis" and cotton and ice. About two hours post operation there was another haemorrhage. Lister precautions. Infection.	Recovery.	Patient became so exsanguinated in the course of the operation that an Esmarch bandage was applied above the pelvis.
39	Berruti, L., Ospedale Mauriziano, Turin. Tre casi di gozzo guariti colla esportazione. Gior. della R. accad. di med. di Torino, 1882, 3 s., xxx, 808. Obs. I, 808.	M. 11 yrs.	Rounded tumor on the right side, size of an orange. Duration about one year.	Severe dyspnoea.	Puncture and iodine treatment without effect. April 16, 1882. Two cysts were removed on the right side. Finding the left lobe "hypertrophied" the whole gland was removed, according to the method of Billroth. The superior and inferior thyroid arteries were "previously ligated."	Recovery.	Longitudinal incision still employed. First instance in Italy of preliminary ligation of the thyroid arteries.
40	*Idem.* Obs. II, p. 809.	F. 42 yrs.	Colloid goitre, the size of a hen's egg, on the right side. Left lobe "especially hypertrophied." Duration from childhood.	Dyspnoea; dysphagia.	Op. I.—June 5 (1882?). Removal of tumor on right side. Op. II.—June 22 (year?). "The entire thyroid gland was removed." This operation "was rather long and difficult."	Recovery.	The second operation was performed because no relief followed the first.
41	*Idem.* Obs. II, p. 811.	F. 18 yrs.	Large cystic tumor in an "hypertrophied" left lobe. Duration 18 months.	Dyspnoea; dysphagia.	June 13, 1882. Left lobe of the thyroid gland entirely removed. "Each little vessel was ligated."	Recovery.	Presumably the "hypertrophy" of the left lobe which contained the cyst was due to presence of other adenomata.
42	Minich, Ospedale Civile di Venezia. Maria, G. B., Esportazione e guarigione di un gozzo mediante il laccio elastico. Gazz. med. ital., lombardia, Milano, 1882, xlii, 103.	F. 50 yrs.	Ovoid tumor at the level of the thyroid cartilage, on the right side of the neck, the size of a large orange. Near this is another small mobile tumor, the size of a pigeon's egg. Duration 34 years.	No symptoms.	Sept. 24, 1881. Enucleation of tumor. Elastic ligature applied to the base. Strict antiseptic precautions.	Recovery.	Sept. 27, 1881. With the scissors the gangrenous tumor was detached about one-half cm. from the ligature. Sept. 28. Patient is almost voiceless and unable to swallow. Oct. 19, 1881. The ligature fell away. Oct. 29. The difficulty in swallowing and loss of voice were of short duration.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
43	Ruggi, G., Ospedale Maggiore di Bologna. Brugia, R. Due casi di gozzo follicolare curati con l'estirpazione della glandiola tiroidea. Guarigione. Raccoglitore medico, Forlì, 1883, s. 4, xx, 373. Case I, p. 376.	M. 22 yrs.	Large tumor in front of the neck, divided in two by a longitudinal sulcus, the right side larger than the left. Duration 10 years.	Slight dysphagia; severe dyspnoea; slight cyanosis; pupils are dilated and react very slowly.	Nov. 15, 1882. Excision of entire gland. Enucleation of a little nodule projecting from the right half of the gland which compressed the trachea. Fifty-four catgut ligatures were applied, the four thyroid arteries included. Rigorous antiseptic precautions were used. After the operation, as before, the pulse was 70.	Recovery.	Dec. 22, 1882. Pleurisy. Vertical incision supplemented by transverse ones; vessels ligated as encountered; isthmus ("pedicle") carefully dissected from trachea (for first time in Italy).
44	*Idem.* Case II, p. 387.	F. 12 yrs.	Hypertrophied thyroid, divided in two by a longitudinal sulcus, the right half flatter and extended, the left more prominent. Small hard, resistant nodules palpated between the right sternomastoid and the end of the right half of the tumor.	Severe dyspnoea, accompanied by a sense of distress.	April 22 (year not given). Total excision of thyroid. The same method was followed as in the preceding case. Thirty-five catgut ligatures were applied. Antiseptic dressing.	Recovery.	Semilunar flap (for first time in Italy).
45	Bottini, E., University of Pavia. Zambianchi, F., Sulla metodica estirpazione del gozzo. Annali universali di med. e chir., Milano, 1883, cclxv, 350. Obs. I, p. 356.	M. 11 yrs.	"Parenchymatous goitre, the size of a small melon, in the middle of the neck, a little more developed toward the right." Duration about two years.	Dyspnoea.	Dec. 6, 1881. Enucleation.	Recovery.	"The parenchymatous tumor was interspersed with small cysts."
46	*Idem.* Obs. II, p. 357.	F. 22 yrs.	"Parenchymatous goitre, the size of the head of an infant, occupying the front and sides of the neck. It is formed of three lobes, the left as large as the other two together." Duration 11 years.	Dyspnoea; attacks of suffocation.	March 4, 1882. "Total extirpation." A severe haemorrhage occurred in isolating the tumor behind the insertion of the sternomastoid, which was controlled with difficulty.	Recovery.	Not clear that this was a total extirpation. Wound suppurated. "The tumor consisted of small cysts enclosed in colloid substance." "When 15 years old, patient was attended by Professor Porta at Pavia, who treated her with a seton."
47	*Idem.* Obs. III, p. 363.	F. 39 yrs.	Parenchymatous goitre, the size of the head of an infant, on the left side of the neck. Duration 19 years.	Dyspnoea; voice weak; difficulty of speech.	April 25, 1882. This operation was just like the preceding one, the only difference being that some skin, which had been stretched over the tumor, was removed.	Recovery. Some disturbance of respiration on account of S-shaped deformity of the trachea.	"The tumor consisted of numerous cysts with colloid contents."
48	*Idem.* Obs. IV and V, pp. 365 and 366.	F. 17 yrs.	First admission: Jan. 21, 1882. Cystic adenoma, the size of a hen's egg, in the lower part of the right carotid region. Duration 10 years. Second admission: Jan. 24, 1883. Cystic adenoma, the size of a hen's egg, behind the left sternomastoid. Duration about two months.	Dyspnoea. Dyspnoea.	Four years previously the tumor had been punctured in the Pavia clinic. Op. I.—Jan. 31, 1882. "Operation was a little difficult on account of firm adhesions, but the tumor was isolated in a short time. Drainage; twisted sutures." Op. II.—Jan. 24, 1883. "Total extirpation."	Recovery. Discharged cured Feb. 26, 1882. Recovery. Post second operation, tetany.	The typical attacks of tetany, called convulsions, were first observed Feb. 6, 13 days after the second operation. The patient, greatly agitated, noisy and destructive, became unmanageable and was discharged Feb. 19. March 16, 1883, the patient returned to have a fistulous tract cured, but became so excited that she was again dismissed.

TABLE II.—ITALY—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
49	*Idem.* Obs. VI, p. 368.	M. 48 yrs.	"Cystic goitre with calcareous concretions on the right side of the neck, the size of a large melon." Duration 28 years.	Abscess, the result of treatment by leeches and poultices.	Dec. 14, 1882. Enucleation.	Recovery.	
50	*Idem.* Obs. VII, p. 370.	F. 21 yrs.	A tumor in the centre of the neck, another to the left. To the right is a nodule the size of a mandarin with many nodules of varying sizes in groups. Diagnosis: "Goitre and sarcoma of left cervical glands." Duration of tumor in the center of neck, 10 years Of the one to the left, 13 months.	Dyspnoea; dysphagia; bass and raucous voice.	March 11, 1883. The two tumors and "the other glands" were removed. The wound was closed with two drainage tubes and twisted sutures.	† Died March 18, 1883. Pneumonia.	Autopsy: "The tumor was a sarcoma of the thyroid gland infiltrating all the cervical glands."
51	*Idem.* Obs. VIII, p. 374.	M. 16 yrs.	Cystic goitre, the size of an orange, in the lower part of the neck, a little to the left. Duration about five years.	Dyspnoea; attacks of suffocation.	May 26, 1883. Enucleation. "Very little loss of blood." The tumor was found to extend below the clavicle. "The trachea did not assume its normal position, and the breathing was not improved."	† Died June 5, 1883.	Autopsy: "A piece of the thyroid lobe was found reaching behind the trachea, compressing it laterally and pushing it to the right. This was undoubtedly the cause of the attacks of suffocation and of death."
52	*Idem.* Obs. IX, p. 376.	M. 63 yrs.	"Sarcoma of the thyroid filling completely the jugular fossa and reaching deeply behind the sternum. Duration about four months.	Voice bass and raucous; dyspnoea; dysphagia; attacks of suffocation.	May 26, 1883. The operator did not succeed in freeing the tumor from the sides of the cartilage of the larynx or from the first rings of the trachea. Using the "Tauschbatterie" to control haemorrhage, the greater part of the tumor was cut out, and the remainder was scraped out with a Volkmann spoon.	Uneventful recovery.	Oblique longitudinal incision. Microscopic examination: "Sarcoma." "The wound healed by granulation." One would not have expected this.
53	*Idem.* Obs. X, p. 378.	F. 25 yrs.	Cystic tumor, as large as an orange, filling the jugular fossa and extending behind the sternum.	Low, raucous voice and difficulty in speaking; severe respiratory disturbance.	June 2, 1883. Slightly oblique incision from right to left. Not succeeding in isolating the tumor from above, the portion behind the sternum was lifted out, thus relieving the respiration. This portion was larger than appeared at examination, and its isolation was laborious on account of the firm adhesions and the large vessels encountered. Trachea small and flattened laterally.	Recovery.	Specimen: There were cysts, varying in size, in the tumor.

TABLE III.—GREAT BRITAIN AND IRELAND

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
1	Gooch, Benjamin. A brief account of bronchoceles. Med. and chir. observations, 1773, iii, 134.	F.	(?)	(?)	Ineffectual attempt at removal. Operation performed by another surgeon notwithstanding protest from Gooch.	† Died "in less than a week." Bleeding never controlled.	Operation discontinued on account of haemorrhage.
2	*Idem.*	F.	(?)	(?)	Nearly fatal haemorrhage. Gooch protested against the operation.	Recovery.	"The young lady's life was preserved only by having a succession of persons to keep constant pressure upon the bleeding vessels day and night for near a week, with their fingers upon proper compresses," *vid.* text.
3	Blizard, Sir Wm. Burns, Allan, Observations on the surgical anatomy of the head and neck, Edinburgh, 1811, p. 202. "From manuscript notes taken by Dr. Brown."	.....	.....	.....	Date not given. Ligation of "the arteries going to an enlarged thyroid gland." (Superior thyroid arteries.)	† Died of hospital gangrene.	Post operation: "In a week the tumor was reduced one-third in its size. The ligatures then sloughed off; repeated bleeding took place from the arteries, and by the extension of the hospital gangrene, the carotid itself was laid open."
4	Coats, Henry, R. C. S., surgeon of the Salisbury Infirmary. Cooper, Sir Astley, Case of bronchocele in which the superior thyroideal artery was successfully tied. Med. chir. trans., Lond., 1819, x, 312.	F. 17 yrs.	"The thyroid glands were large and pressed on the trachea."	Dyspnoea; dysphagia.	Dec. 29 (1818?). Ligation of left superior thyroid artery.	Improved.	"Her breathing much improved and the size of the tumor reduced nearly half." "Discharged Feb. 14, quite well." Possibly infection of the wound contributed to the exceptional result.
5	Key, Guy's Hospital. Case of bronchocele. Lancet, Lond., 1824, ii, 358.	F. 28 yrs.	General enlargement of thyroid, particularly of right lobe. Duration two years.	Marked exophthalmus; nervousness: livid countenance; irritability; vertigo; headache; dysphagia.	June 11 (year not given). Ligation of right superior thyroid artery—undoubtedly only its median branch. Duration of operation one hour.	† Died two days post operation.	Unmistakably a case of Graves' disease. Graves' paper appeared in 1835. Operator greatly embarrassed by a superficial vein. First day post operation the patient was bled and cupped.
6	Earle, H., F. R. S., St. Bartholomew's Hospital. Case of bronchocele, in which the superior thyroid arteries were tied. Lond. Med. and Phys. Jour., 1826, lvi, 201.	F. 17 yrs.	Bronchocele of considerable magnitude, in front of neck. Duration four years.	Interrupted menstruation; dyspnoea; dysphagia; headache. "State of health in every respect bad." Pulse 120. Greatly enlarged superior thyroid arteries.	Op. I.—Aug. 2, 1823. Ligation of right superior thyroid artery which was "as large as a carotid artery." Op. II.—Sept. 11, 1823. Ligation of left superior thyroid artery.	Recovery.	Tumor diminished in size. Dyspnoea and dysphagia disappeared. Perhaps earliest case in which pulse rate is mentioned. Undoubtedly a case of hyperthyroidism. Perhaps the first operation for Graves' disease. Jan., 1824. "Health greatly restored." The infection which followed operation in these days was probably responsible for the good result of trivial operative measures.

TABLE III.—GREAT BRITAIN AND IRELAND.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
7	Green. Removal of the right lobe of of the thyroid gland. Lancet, Lond., 1829, ii, 351.	F. 24 yrs.	"Enlarged thyroid gland." No further details.	None mentioned.	May 22, ——. Operator believes that he removed the right lobe. "It was impossible to remove the whole of the gland on account of the large vessels in the neighborhood."	† Died about 15 days post operation, probably from infection.	Report of operation and of the case very meagre and indefinite; am unable to state what part or what kind of gland was removed.
8	Liston, R., Edinburgh Royal Infirmary. Enlargement of the isthmus of the thyroid gland—removed. Lond. Med. Gaz., 1830, vi, 477.	M. 47 yrs.	Tumor of isthmus "larger than a goose's egg." Duration about three years.	Dyspnoea; voice "considerably impaired."	Feb. 10, ——. Tumor "detached from its more loose connexions." The "remaining attachment" transfixed and ligated. Tumor left to slough away. "Surrounded the lower part of the tumor by two semicircular incisions."	Recovery.	Profuse bleeding—". . . . if the operation had been finished by means of the knife, the patient might have sunk before the haemorrhage could have been arrested, it being impossible to apply any great degree of pressure in that situation."—Liston.
9	Brodie, St. George's Hospital. Ligature of the thyroid artery, for enlargement of the thyroid gland. Lancet, Lond., 1832, ii, 314 and 479.	M.	Tumor of right thyroid gland.	.....	June 21 (1832?). "Ligature of the right superior thyroid artery." Evidently its median branch.	Recovery.	No subsequent note.
10	Liston, Robert, North London Hospital. Wilson, W. J. E., Cases of removal of part of the thyroid gland. Brit. Annals of Med., Pharm., etc., Lond., 1837, i, 11.	F. 23 yrs.	Large goitre, greater on right side. Duration eight years.	Dyspnoea.	Dec. 14, ——. Transfixion of tumor of right lobe and ligation. Removal by strangulation.	Recovery.	Probably cretinoid child.
11	Liston, Robert, F. R. S., University College Hospital. Bronchocele. Division of the sternomastoid muscle. Lancet, Lond., 1840, ii, 31.	M. 43 yrs.	Large bronchocele on left side of neck. Duration six years.	Dyspnoea.	Jan. 28 (year not given). Sternomastoid muscle divided to relieve pressure.	Recovery. Dyspnoea somewhat relieved.	No attempt made to remove the tumor. England's most dexterous operator evidently helpless when confronted with a goitre.
12	*Idem.* Bronchocele treated by ligature. Lancet, Lond., 1841, i, 691.	F. 13 yrs.	Bronchocele, size of small orange, on right side. "Always had slight swelling." Rapid increase in size in last two years.	Respiration impeded only "when child laughs."	Oct. 26, ——. Transfixion and ligation of pedicle.	Recovery.	Eighth day patient fainted from profuse secondary haemorrhage. Seventeenth day, haemorrhage.
13	*Idem.* Case I.—Encysted tumor on the thyroid body. Lectures on the operations of surgery, Phila., Liston & Mütter, 1846, 320.	..... 2½ yrs.	Encysted tumor, size of an apple, "upon the box of the larynx." Present from birth.	Caused no symptoms.	No date. Enucleation of "sac containing a thin pellucid fluid."	Recovery.	Relation to thyroid gland not determined.
14	*Idem.* Case II.—Cystic tumor on the thyroid body. Lectures on the operations of surgery, Phila., Liston & Mütter, 1846, 321.	M. 10 yrs.	Cystic tumor, size of small hen's egg, "front of throat." Existed since birth.	"Inconvenience."	Nov. 11, ——. Enucleation of cyst. Precise situation not stated. No vessels ligated.	Recovery.	Considered by Liston to be a tumor of the thyroid gland.

TABLE III.—GREAT BRITAIN AND IRELAND.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
15	Cusack, S. A., F. R. C. S., Steevens' Hospital. Case of dyspnoea from bronchocele relieved by the division of the cervical fascia. Dublin Hosp. Gaz., 1857, iv, 276.	M. 17 yrs.	Bronchocele. Duration about four years.	On admission, March 12, 1857, laborious breathing. March 13, comatose; respiration 5; "pulse slow and feeble."	March 13, 1857. Laryngotomy and tracheal catheter.	Recovery.	Larynx and wound closed in seven days. ". . . . peas were placed in the external wound to keep up the discharge." Operator helpless.
16	Parsons, D. W., Dublin. Removal of an osseous tumor from the thyroid gland. Med. Times & Gaz., Lond., 1862, ii, 685.	F. 21 yrs.	Osseous tumor, size of bantam's egg, in right lobe. Duration about 10 years.	Dysphagia and aphonia.	Date not given. Enucleation.	Recovery.	Tumor, sawed in two, was found to be "composed of perfectly formed ossific matter."
17	Hamilton, E., F. R. C. S. I., Steevens' Hospital. Extirpation of the thyroid body. Dub. Quart. Jour. Med. Sci., 1865, xl, 315. Illustrations.	F. 16 yrs.	Large colloid goitre.	.....	June 10, ——. Both lobes were dislocated so as to protrude out of the wound. "Pedicle" tied by encircling ligature caused alarming asphyxia; therefore, transfixed and ligated.	Recovery.	Patient fainted from great loss of blood. The "pedicle" in this case was the part adherent to the trachea (the isthmus). Operator surprised to find that the goitre could be so easily dislocated.
18	King, K., Hull General Infirmary. Cases of bronchocele of the isthmus of the thyroid body; with remarks on the practicability of excision under certain circumstances. Case II. Brit. Med. Jour., Lond., 1865, ii, 5.	M. 21 yrs.	Bronchocele, size of a hen's egg, in front of trachea. Duration "long time."	Dyspnoea.	Nov. 13, 1864. Incision, eventration and ligation of neck of sac. Tracheotomy two hours post operation, presumably necessitated by asphyxia due to the encircling ligature.	† Died two days post operation.	Autopsy: Both lobes studded with small tumors, evidently adenomata.
19	*Idem.* Case III, p. 6.	M. 21 yrs.	Bronchocele, size of a hen's egg, in front of trachea. Both lobes slightly enlarged. Duration three or four years.	Dysphagia; dyspnoea.	May 9, 1865. Blunt enucleation of central tumor.	Recovery.	In course of operation, other tumors were observed on each side of the central one—operator "resisted temptation" to remove them.
20	Poland, Alfred. Tumor of the neck in connection with the thyroid gland; removal; structure thyroidal; recovery. Guy's Hosp. Reports, Lond., 1871, s. 3, xvi, 484. One woodcut showing a few follicles.	F. 40 yrs.	Tumor, "size of shaddock," front and right side of neck. Undoubtedly adenoma. Duration 26 years.	Dyspnoea; dysphagia.	May, 1870. Enucleation. The tumor had only "an adhesive connection with the side of the thyroid gland." Operator realized that he had not removed the right lobe of the gland.	Recovery.	Carefully performed operation by an unusually competent surgeon.

TABLE III.—GREAT BRITAIN AND IRELAND.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
21	Durham, A. E., Guy's Hospital. Removal of cystic bronchocele. Lond. Med. Record, 1873, i, 209. Case first briefly reported in the Brit. Med. Jour., Lond., 1873, i, 286.	F. 36 yrs.	Cystic bronchocele of isthmus, size of large orange. Duration about five years.	Dyspnoea; dysphagia.	Date not given. Enucleation.	Recovery.	The two lobes were seen and appeared to be normal. The tumor was, evidently, an adenoma with degenerated centre.
22	*Idem.* Removal of bronchocele. Guy's Hosp. Gaz., 1873, ii, 38.	F. 47 yrs.	Bronchocele 19½ inches in circumference. Duration 20 years.	.....	Date not given. Either an excision of both lobes or enucleation of a large adenoma from each side. Description of operation not sufficiently definite.	Not stated.	Mr. Durham thought that thyrotomy would be an appropriate name for this operation. Torsion was applied to all the arteries; the veins were ligated with catgut.
23	Holmes, Timothy, surgeon to St. George's Hospital and professor of surgery and pathology, Royal College Surgeons. A case in which a large bronchocele was removed with fatal result. Amer. Jour. Med. Sci., Phila., 1873, n. s., lxv, 17. Illustration.	F. 65 yrs.	Enormous cyst of thyroid which hung below patient's waist. Weighed about seven pounds. Duration about 40 years.	So greatly reduced in strength that death seemed inevitable.	June 19, 1872. Skilfully and carefully performed extirpation. Vessels tied as encountered.	† Died 39 hours post operation. Haemorrhage and erysipelas.	*Vid.* abstract and illustration given in text. The innominate artery could be felt; the subclavian passed in front of the pedicle.
24	Jessops, Leeds General Infirmary. Cystic enlargement of thyroid body; extirpation; recovery. Lancet, Lond., 1873, ii, 841.	M. 7 yrs.	Cyst of right lobe and isthmus, size of small hen's egg. Duration about four years.	No symptoms.	Oct. 2, 1873. Extruded by pressure through incision of 2 inches. Pedicle at isthmus transfixed and ligated.	Recovery.	
25	Syme, James. Watson, P. H., Excision of the thyroid gland. Edinb. Med. Jour., 1874, xix, 252.	(?)	Cystic goitre.	.....	Cyst tapped and then opened, because "aneurismal signs" developed. Haemorrhage uncontrollable. The "patient died in our hands" writes Watson.	† Death from haemorrhage.	Note that in these recent days a great surgeon was powerless when confronted with blood vessels. Patrick Heron Watson assisted at the operation.
26	Spence, Prof. *Ibid.*	(?)	Tumor of isthmus of the thyroid gland.	.....	Extirpation of tumor of isthmus. "Great bleeding attending upon the division of the vascular connexion."	Recovery.	Watson assisted.
27	Watson, Patrick Heron, F. R. S., F. R. C. S. E., Edinburgh. Excision of the thyroid gland. Case I. Edinb. Med. Jour., 1874, xix, 252.	F.	"Central tumor, size of a China orange." Duration "many years."	.....	May, 1871. Excision of both lobes—the second lobe by his special method.	Recovery.	*Vid.* abstract and comments on Watson's method in text. Profuse haemorrhage on freeing the first lobe.
28	*Idem.* Case II, p. 253.	F.	Multilocular cystic goitre, size of two fists.	Anaemia; slight degree of exophthalmus. Pulse not mentioned.	May, 1871. Excision of both lobes by Watson's method.	Recovery.	The goitre was probably made up of adenomata with cystic degeneration. In course of operation the long silk ligature, which included the vessels of the left superior pole, slipped. The gush of blood was controlled by pressure of sponge, no attempt being made to catch the vessels.

TABLE III.—GREAT BRITAIN AND IRELAND.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
29	*Idem.* Case III, p. 254.	F.	Multiple cystic goitre.	Anaemia; exophthalmus. No mention of other symptoms of hyperthyroidism.	Autumn 1871. Excision of both lobes by Watson's method.	Recovery. "The anaemia and exophthalmia which were present on admission, markedly diminished after the operation."	Catgut ligatures used and cut short. Presumably an adenomatous goitre, inasmuch as patient had exophthalmus.
30	*Idem.* Case IV, p. 254.	F.	Multiple cystic goitre.	.....	1872. Excision of both lobes—Watson's method.	Recovery.	
31	*Idem.* Case V, p. 254.	F.	Multiple cystic goitre, size of large fist; it "had grown steadily for 23 years."	Anaemia; exophthalmus. The goitre pulsated.	March 1, 1872. Excision of both lobes.	Recovery. No note as to effect of operation upon the exophthalmus.	"A pulsating swelling" with bruit developed in the situation of the right superior pole six weeks or more after operation. "It then presented all the characters of an aneurysm with a venous communication." In about three weeks it disappeared.
32	*Idem.* Excision of the thyroid gland. Brit. Med. Jour., Lond., 1875, ii, 386. Case VI, p. 387.	(?)	.....	.....	Watson's method.	Recovery.	
33	*Idem.* Case VII, p. 387.	(?)	.....	.....	Watson's method.	Recovery.	
34	*Idem.* Case VIII, p. 387.	(?)	Large tumor adherent to the trachea.	.....	Watson's method.	† Died a few hours after operation.	Profuse haemorrhage. Death caused by aspiration of blood into wounded trachea.
35	Dowson, C. H. Hypertrophy of thyroid gland, and successful removal of right lobe. Trans. Bristol Med.-Chir. Soc., 1874-78, i, 71.	F. 13 yrs.	"Enlarged thyroid gland." right lobe larger than left.	"On July 28, 1874, she appeared premoribund, with stridulous breathing and livid countenance."	July 28, 1874. Excision right lobe. Superior and inferior thyroid vessels ligated as adhesions, but not recognized.	Recovery and relief.	The nature of the goitre is not stated. Creditable operation.
36	Holthouse, Westminster Hospital. Gibb, Sir G. Duncan, Division of the isthmus to relieve dyspnoea in certain cases of bronchocele. Lancet, Lond., 1875, i, 120. Case I, p. 121.	F. 29 yrs.	Enlargement of thyroid gland, right lobe the larger. Isthmus decidedly enlarged. Duration two years.	Facial turgescence; dyspnoea; discomfort and tension about neck; nausea and vomiting for about 10 days.	July 11, 1874. Excision of isthmus.	Recovery and relief.	Sir Duncan writes, "I believe that this is the first occasion in which the isthmus has been either wholly removed or divided, at my suggestion." He would prefer, as a rule, to have "a good large portion of the isthmus" removed.

TABLE III.—GREAT BRITAIN AND IRELAND.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
37	*Idem.* Case II, p. 121.	F. 17 yrs.	Tumor "of the entire front of the neck." Duration since birth.	Dyspnoea; dysphagia; laryngeal cough; facial turgescence.	Dec. 15 (1874?). Aneurism-needle armed with double thread passed under the isthmus. The ligatures were tied at two points with the idea that sloughing would take place between them.	Recovery.	
38	Ticehurst, H. R. Tumor of the thyroid gland. Brit. Med. Jour, Lond, 1875, i, 59	.....	Pendulous tumor, size of "small melon."	.....	Nov. 4, 1874. Blunt dissection. Encapsulated growth removed by galvano-cautery.	Recovery.	Meagre description.
39	Spence, Professor, Royal Infirmary, Edinburgh. From notes of Mr. T. F. Chavasse. Excision of a large bronchocele. Lancet, London, 1877, ii, 843.	F. 13 yrs.	Large bronchocele involving the entire gland. Right side of neck larger than left. Duration three years.	Dyspnoea; "thrill over praecordia; first cardiac sound at apex somewhat thumping; second sound accentuated. No exophthalmus."	Sept. 28, 1877. Total excision after method of Patrick Watson, except that the isthmus was divided and each lobe removed separately.	† Died within 24 hours; possibly of hyperthyroidism.	Clever operation. Trachea flattened from side to side. Sternohyoid, omohyoid and thyrohyoid muscles divided. "Considering the vascularity of the organ, comparatively little haemorrhage occurred." First instance in Great Britain of division of isthmus and removal separately of each lobe.
40	McLeod, Surgeon-Major K. Successful removal of bronchocele. Indian Med. Gaz., Calcutta, 1880, xv, 250.	M. 29 yrs.	Goitre, "size of child's head, more prominent on the right than on the left side." Duration eight years.	Respiration and deglutition not impeded.	July 22, 1880. Excision of entire gland, according to the method of Watson, the author states. Antiseptic precautions.	Recovery.	From the author's description of the operation one would conclude that the method employed was not precisely Watson's. Professor McConnel, who examined the specimen, compared its size to a man's fist.
41	Purcell, F. A. Cancer Hospital, Brompton. Removal of the right lobe of the thyroid. Lancet, Lond., 1880, ii, 339.	F. 23 yrs.	Tumor, size of duck's egg, right side of neck, extending from about third ring of trachea to upper border of thyroid cartilage, overlapped by edge of sternomastoid muscle. Thickening of isthmus. Duration three years.	.....	July 20, ——. Blunt dissection and excision, right lobe and isthmus. Antiseptic precautions, including carbolic spray.	Recovery.	The tumor was probably an adenoma and presumably enucleable.
42	Rose, W. Tumor of thyroid; removal. Brit. Med. Jour., Lond., 1881, i, 232.	F. 27 yrs.	Bronchocele, size of a turkey's egg, right lobe. Duration eight years.	Dyspnoea; suffocation; pain.	Dec. 16, 1880. Blunt and bloodless enucleation and ligation of pedicle with "loop of carbolized catgut."	Recovery.	"The tumor was found to be composed of hypertrophied gland tissue." It was, presumably, an adenoma.
43	Whitehead, W., F. R. C. S., F. R. S., Edin., Manchester Royal Infirmary. Excision of the thyroid gland. Brit. Med. Jour., Lond., 1881, ii, 779.	F. 51 yrs.	Pendulous 'goitre extending from thyroid cartilage to sternum. Both lobes enlarged. Duration 30 years.	Dyspnoea; suffocation; hoarseness.	May 21, ——. Excision of entire thyroid gland by Watson's method. Antisepsis.	Recovery.	June 29, ——. "The voice has been daily improving, and in every other respect the patient had regained perfect health."

TABLE III.—GREAT BRITAIN AND IRELAND.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
44	Pitts, B., Resident Surgeon, St. Thomas' Hospital. Case of bronchocele in which the thyroid was removed during an attack of dyspnoea. Case I. Tr. Path. Soc., Lond., 1882, xxxiii, 364.	M. 15 yrs.	"Bronchocele." Duration eight years.	Dyspnoea.	Oct. 26 (1881?). Preliminary venesection from jugular vein; only 1½ ounces dark blood flowed. Tracheotomy. Gland was removed "without the loss of any material additional blood."	† Died the day after operation.	Meagre report.
45	*Idem.* Case II, p. 365.	F. 33 yrs.	Large bronchocele mainly on left side. Duration "ever since she could remember."	Great dyspnoea; stridulous breathing; voice hoarse; left vocal cord paralyzed.	Dates not given. Op. I.—Gland incised. Op. II.—Gland incised. Op. III.—Tracheotomy.	† Died about six weeks after first operation.	Operations undertaken in attacks of extreme dyspnoea.
46	Barker, A. E. Excision of small goitre: recovery. Brit. Med. Jour., Lond., 1883, i, 1066.	F. 21 yrs.	Tumor of right lobe, 3 inches in transverse diameter, 2 inches in vertical. Evidently an adenoma. Duration seven years.	Dyspnoea, paroxysmal at times; anaemia and "vascular excitement."	Aug. 24, 1881. Excision of right lobe. Vessels tied as encountered.	Recovery.	Prior to operation had been treated with leeches, injection of iodine, seton, electricity.
47	May, Bennett, Queen's Hospital, Birmingham. Case of excision of large bronchocele, with preliminary tracheotomy. Brit. Med. Jour., Lond., 1883, i, 1227.	F. 42 yrs.	Large tumor "covering the trachea from the hyoid bone down to the sternum." Duration 20 years.	Dyspnoea; cough; voice faint and husky; slight exophthalmus.	(1881?). Preliminary tracheotomy. Excision.	† Died four days post operation.	Treated with injections and with hydrofluoric acid, iodine, ergotin, etc., by mouth. Tapped and only blood obtained. Death "apparently from suppurative bronchitis." Operator states that it was "probably an adenoid tumor undergoing sarcomatous change."
48	Stoker, W. T., F. R. C. S., professor anatomy, Royal College Surgeons, Ireland. On removal of the thyroid gland. Tr. Acad. Med., Ireland, Dublin, 1883, i, 231, 295.	M. 17 yrs.	"Enormous goitre involving the entire gland." "Hanging down as low as the abdomen." Duration since birth.	"Cretinish"; constant cough; laryngeal irritation; stridulous breathing; "impending death."	March 10, 1882. Op. I.—Excision of right lobe and isthmus. Two and one-half hours. March 8, 1883. Op. II.—Excision of left lobe. Two hours. Antiseptic precautions.	† Died fifth day after second operation, sepsis and pulmonary thrombosis.	Difficult operations, cautiously and admirably performed. Autopsy: Thrombosis of pulmonary artery and of internal jugular, innominate and superior cava veins, due undoubtedly to the infection of the wound which had filled with blood.
49	Jones, Sydney, St. Thomas' Hospital. Enlargement of the thyroid gland in a male, producing pressure on the trachea and serious attacks of dyspnoea; removal of isthmus; atrophy of lateral lobes; cure. Lancet, Lond., 1883, ii, 900.	M. 18 yrs.	"Greatly enlarged thyroid gland." Duration seven or eight years.	Dyspnoea.	March 17, 1883. Excision of isthmus between silk ligatures, which were left hanging out of wound "for drainage." Drainage tube.	Recovery. Complete relief.	The trachea was found at operation to be flattened from side to side. May 4, 1883. "The thyroid cannot be felt."

TABLE IV.—UNITED STATES AND CANADA

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
1	Harris, Charles, New York, 1807. Gross, S. D., Diseases of the thyroid gland. System of Surgery, Phila., 1882, 6th Ed., ii, 354.	F.	Goitre extending from chin to sternum and from ear to ear. Duration 22 years.	.....	1807. Freed with knife and fingers up to tracheal attachment; base tied off with stout ligature.	Recovery.	Only two small arteries tied.
2	Mott, Valentine, professor of surgery, N. Y. *Ibid.*	.....	.....	.....	Removed goitre weighing three pounds.	† Died.	
3	Jameson, H. G., Baltimore, Md. Case of bronchocele relieved by taking up one of the superior thyroid arteries. American Medical Recorder, Phila., 1822, v, 116.	F.	General enlargement of thyroid gland. More or less circumscribed tumor of left lobe. Duration about 20 years.	Dysphagia; difficulty of speech; strong pulsation of left carotid and superior thyroid arteries.	May 10, 1821. "Superior thyroid artery" ligated with "animal ligature."	Recovery.	Mistaken for aneurism of carotid by many physicians.
4	Smith, N. R., professor of surgery, University of Maryland, Balto., Md. Extirpation of the thyroid gland. North American Archives M. & S. Sci., Balto., 1835, ii, 309.	F. 40 yrs.	Large, somewhat pendulous, tumor of right lobe. Duration presumably 20 years.	Ulceration of skin over lower part of tumor.	Date not given. Probably an enucleation of large adenoma of right lobe.	† Death on the 13th day post operation. Sepsis.	Case fully described in text. Operation skillfully performed. Superior thyroid artery wounded and secured early in operation.
5	Hoyt, O. Tumor of the thyroid gland successfully extirpated. Boston Med. & Surg. Jour., 1847, xxxv, 297.	F. 30 yrs.	Large tumor of left lobe. Duration five years.	Dysphagia; dyspnoea.	Aug. 13, 1835. Extirpation of tumor, probably an adenoma. Dissection from below upwards along inner border.	Recovery.	Inferior thyroid artery closed by torsion; furious bleeding from accidentally divided superior thyroid artery controlled by actual cautery applied blindly in pocket. Patient was bled 18 ounces on day following operation.
6	Otis, G. A., Richmond, Va. A report of a case in which an enlargement of the isthmus of the thyroid body was successfully extirpated. Virginia Med. & Surg. Jour., Richmond, 1854, ii, 115.	F. 26 yrs.	Tumor of isthmus, size of hen's egg. Thick fibrous capsule, very vascular interior. Duration 12 years.	Dysphagia; dyspnoea.	Sept. 7, 1853. Removed by strangulation; transfixion with two needles armed with double ligatures of silk, the eight ends of which were tied each to the ones adjacent.	Recovery.	"The internal portion of the tumor closely resembled the parenchyma of the placenta, a similitude I borrow from Sacchi, who has noticed this species of goitre." It was "a spongy tissue composed almost exclusively of a congeries of enlarged vessels."
7	Toland, H. H., San Francisco, Cal. Enlargement of the isthmus and right lobe of the thyroid gland with bony deposit; operation; cure. Pacific Med. & Surg. Jour., San Francisco, 1858, i, 53.	M. 26 yrs.	Enlargement of isthmus and right lobe. "Irregular and large portions of bone rested on the trachea." Duration nine years.	Vertigo; dyspnoea; aphonia.	Dec. 1, 1857. Short incision into tumor and eventration. Profuse haemorrhage controlled by ligating wall of sac under transfixing tenaculum.	Recovery.	On eventration "blood gushed from the wound in fearful quantity."

TABLE IV.—UNITED STATES AND CANADA.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation.	Result	Remarks
8	Cooper, E. S., professor of anatomy and surgery, University of the Pacific, San Francisco. Operation for the removal of bronchocele. Death of the patient. Cinn. Lancet & Observer, 1860, iii, 15.	F. 24 yrs.	Circumscribed bronchocele, left side, extending from clavicle to chin. Duration four years.	Tumor apparently so vascular that consultants diagnosed aneurism.	No date. Futile attempts to use écraseur. Excision after preliminary ligation of the carotid.	† Died five hours post operation. Haemorrhage.	Inferior thyroid and four other arteries tied in course of operation. Abstract in text.
9	*Idem.* Cutting away of bronchocele without haemorrhage, with a case. Remarks. Med. & Surg. Reporter, Phila., 1862, viii, 38.	F. 27 yrs.	Bronchocele of isthmus, size of hen's egg. Duration 10 months.	"Mental anxiety."	March 27, 1861. Transfixed above and below, tied, and excised above ligatures.	Recovery.	States, in general way, that he has previously transfixed thyroid tumors so as to include the thyroid arteries and then transfixed the gland in many places and ligated.
10	Voss. Successful removal of thyroid gland. Amer. Med. Times, N. Y., 1862, iv, 10.	F. 54 yrs.	Tumor, size of fist, chiefly in left lobe and slightly substernal. Duration 42 years.	Dysphagia; dyspnoea; deflected trachea.	Date not given. Removed by écraseur.	Recovery.	Profuse venous bleeding, unmanageable until écraseur was applied.
11	Smith, T. S., Lexington, Mo. Operation for the removal of a single goitrous tumor of the neck. Amer. Med. Times, N. Y., 1863, vii, 168.	Negro. M. 34 yrs.	Cystic tumor, left side.	.....	July 1, 1863. Ligation of artery supposed to be inferior thyroid; operation abandoned for fear of fatal haemorrhage.	.....	Another large vessel, size of goose quill, arising from subclavian, "dipped into the tumor on the under side, passed through it, and again showed itself running along the superior border of tumor . . . . then dipped into it again." Smith believed this to be the transversalis colli. *Vid.* text for Valentine Mott's observations.
12	Cheever, D. W., surgeon, Boston City Hospital, Boston, Mass. Bronchocele originating in America; operation; recovery. Boston Med. & Surg. Jour., 1866, lxxiii, 332.	F. 24 yrs.	"Solid" tumor, a little to the right and just below the larynx. Size 1½ inches by 2 inches.	.....	July 19, 1865. Excision of entire gland. "No very great haemorrhage." The left lobe at operation was found to be much larger than the right.	Recovery.	Only one of the two cases was operated upon. "The ready removal of it without profuse haemorrhage would seem to indicate early surgical interference with these growths." The descriptions of the growth before and at operation conflict. Am in doubt as to the nature of the enlargement.
13	Greene, W. W., Portland, Me. Successful removal of a large bronchocele. Med. Record, N. Y., 1866-67, i, 441.	F. 45 yrs.	Bronchocele weighing 1 pound 9 ounces. Duration 26 years.	Dysphagia; dyspnoea; headache; giddiness.	Aug., 1866? Operation badly described; apparently a one-sided lobectomy.	Recovery.	"Fearful haemorrhage" from veins on exposing the tumor. Pedicle "containing three large arteries," which were his "guides for dividing pedicle into three parts with the fingers."

TABLE IV.—UNITED STATES AND CANADA.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
14	Marshall, E. L., Keithsburg, Ill. Extirpation of the entire thyroid gland. Recovery. Chicago Med. Jour., 1867, xxiv, 97.	M. 40 yrs.	Tumor weighing 1 pound 11 ounces. Duration many years.	Dyspnoea; attacks of suffocation; headache; despondency.	Jan. 18, 1852. Excision of entire gland. Anaesthesia declined by patient. Careful ligation of the four thyroid arteries as preliminary to excision.	Recovery.	Operation admirably performed. Marshall reports a lobectomy by Geo. McClellan, Sr., of Philadelphia. (Date not given.)
15	Warren, J. Mason, Boston, Mass. Large encysted thyroid tumor of the neck. Incision. Recovery. Surgical observations with cases and operations, Boston, 1867, 506.	F. 56 yrs.	Large cystic tumor occupying whole front of neck, from chin to sternum. Duration 54 years.	"Fullness in head."	Op. I.—June 20, 1860. Cyst incised and tent introduced. Op. II.—June 30, 1860. "Sac freely incised and covered with large poultice."	Recovery.	
16	*Idem.* Thyroid tumor. Twice removed. *Ibid.*, p. 507.	F. 35 yrs.	Cyst of right lobe. Subsequent cyst in same situation, size of an apple. Duration about seven years.	First tumor painful. Second tumor caused dyspnoea.	Op. I.—Nov., 1851. Extirpation of cyst. Op. II.—May, 1858. Incision of sac and ligation of mouth of sac.	Recovery.	Cyst probably only partially removed at first operation. Repeated haemorrhages for five days after second operation. Sac obliterated by suppuration.
17	Blackman, G. C., professor of surgery, Medical College, Ohio. Pendulous pedunculated bronchocele successfully removed. Amer. Jour. Med. Sci., Phila., 1870, n. s., lix, 93.	F. 36 yrs.	Oblong tumor of isthmus 3½ inches long, circumference 4 inches, "looking much like a banana." Duration 15 years.	Tumor had caused no symptoms. Operation to relieve "unsightly deformity."	Feb., 1869. Extirpation. Blunt dissection; tumor wrenched from its connections.	Recovery.	Tumor being completely isolated was "suddenly wrenched from its connections," thereupon appalling haemorrhage from superior and inferior thyroid arteries. Bleeding controlled by sponges retained by transfixing needle and twisted suture.
18	Greene, W. W., Portland, Me. Three cases of bronchocele successfully removed. Amer. Jour. Med. Sci., Phila., 1871, n. s., lxi, 80. Case II, p. 81.	F. 40 yrs.	Tumor, size of small orange, in right lobe.	Dysphagia.	Oct. 25, 1869. Enucleation.	"Recovery."	Simple operation except for "adhesions to esophagus."
19	*Idem.* Case III, p. 82.	F. 35 yrs.	Tumor "involving both lobes, being of immense size."	Headache; vertigo; dysphagia; dyspnoea; aphonia; thrill; bruit. "Pulsated everywhere. Diagnosed aneurism by "a prominent surgeon."	Jan. 20, 1870. Probably a double lobectomy. Vertical transfixion along midline and ligation of "pedicle" on both sides. "Most fearful haemorrhage."	.....	Before operation "considered the chance 100 to 1 that she would die on the table. . . . ." *Vid.* text for author's description.

TABLE IV.—UNITED STATES AND CANADA.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
20	Maury, F. F., Philadelphia Hosp. Extirpation of the thyroid gland for cystic enlargement. Case I. Photographic Review of Med. & Surg., Phila., 1871-72, ii, 17.	F. 23 yrs.	Very large cystic goitre, probably of isthmus and right lobe. Duration 14 years.	Dysphagia; pain; slight dyspnoea.	April, 1871. Excision carefully performed after ligation of four thyroid arteries.	Recovery.	Operations well performed in bloodless manner.
21	*Idem.* Case II, p. 17.	Sex and age not given.	"Another very large growth" similar to that in case given above.	.....	1871. Precise date not given. Similar operation as in case given above.	† Died three weeks post operation. Pneumonia.	The operation was practically bloodless. The patient recoverd normally and at the time of death the wound was almost healed.
22	Hodder, E. M., F. R. C. S., Eng., professor obstetrics, Trinity Hospital, Toronto, Canada. Fibro-cystic disease of the right half of the thyroid gland and its removal. Canada Lancet, Toronto, 1873, v, 159.	F. 18 yrs.	Tumor, size of pullet's egg, at right side of the larynx. (Fibro-cystic.) Duration 2½ years.	Dysphagia; "voice seriously affected."	Op. I.—April 10, 1872. Unnamed surgeon removed "upper portion only of the tumor." Op. II.—Oct. 31, 1872. By Hodder. Enucleation-excision of right lobe, which was hypertrophied and contained an adenoma.	Recovery.	Voice somewhat restored. Dysphagia disappeared. Superior and inferior thyroid arteries were the only ones which required ligation.
23	Fenwick, G. E., Professor of clinical surgery, McGill University, Montreal, Canada. A case of fibro-cystic bronchocele. Removal of the right half of the thyroid body. Canada Med. & Surg. Jour., Montreal, 1873, i, 208. Case, p. 211.	F. 21 yrs.	Fibro-cystic tumor. "Huge central mass and two lateral" portions. Duration 18 years.	Dyspnoea.	About June 8, 1872. Excision of both lobes. Ligation of superior and inferior thyroid arteries "which appeared small." Tumor twice tapped previously.	Recovery.	Presumably an excision of both lobes. The tumor consisted of three distinct lobes. A ligature was applied to the pedicle over trachea. Creditable operation.
24	Milligan and Tupper, Wabasha, Minn. Removal of right lobe of the thyroid gland, for cystic degeneration. Med. & Surg. Reporter, Phila., 1875, xxxii, 361.	F. 40 yrs.	Large cystic tumor, right lobe. Duration a number of years.	Anxiety; nervousness; slight dyspnoea; slight dysphagia.	No date. Enucleation and removal by écraseur, right lobe.	Recovery.	Relatively trivial operation.
25	Nelson, W., Physician accoucheur to the Female Home, etc., Montreal. Fibro-cystic bronchocele. Operation and recovery. Canada Med. Record, Montreal, 1875-76, iv, 79.	F. 32 yrs.	"Fibro-cystic bronchocele, size of small teacup," in left lobe. Duration 16 years.	Difficulty in breathing at times.	Oct. 24, 1874. Probably an enucleation of an adenoma.	Recovery.	Left superior thyroid artery ligated in course of operation.

TABLE IV.—UNITED STATES AND CANADA.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
26	Hamilton, Frank H., New York. Division of isthmus of the thyroid gland to relieve dyspnoea in bronchocele. Med. Record, N. Y., 1876, xi, 4.	M. 50 yrs.	Large bronchocele which encircled the trachea.	Dyspnoea so excessive as to necessitate support of tumor by an attendant for three days prior to the operation.	Jan. 8, 1849. Division of isthmus and removal, perhaps, of part of goitre without relief of dyspnoea. Hence tracheotomy.	† Died three days and four hours post operation.	Cause of death not stated.
27	Gay, G. W., Massachusetts General Hospital, Boston, Mass. Goitre. Bost. Med. & Surg. Jour., 1876, xciv, 727.	F. 20 yrs.	Solid tumor 6 inches x 8 inches. Duration two years.	Slight tracheal obstruction.	March 25, 1876. Enucleation of tumor—probably adenoma. Pedicle in midline transfixed and tied.	Recovery.	Simple operation. Carbolic acid dressing. First case in America in which mention is made of an antiseptic. Year of Lister's visit to America.
28	Homans, J., Carney Hospital, Boston, Mass. Cystic adenoma of the thyroid; excision; cure. Bost. Med. & Surg. Jour., 1876, xciv, 44.	F. 32 yrs.	Cystic adenomata of isthmus of left lobe. Duration eight years.	Dyspnoea.	Op. I.—Nov. 21, 1875. Excision-enucleation of tumor over trachea. Cretaceous contents. Op. II.—Dec. 15, 1875. Excision-enucleation of tumor of left lobe.	Recovery.	After first operation: Left vocal cord immovable. Operation carefully performed by blunt dissection and in fairly bloodless manner.
29	Willoughby, W. A., Colborne, Ontario. Sinclair, J. A., Removal of right thyroid gland. Canada Lancet, Toronto, 1876-77, ix, 73.	M. 19 yrs.	Right thyroid gland enlarged. (Somewhat larger than human heart.) Duration four years.	Pressure on larynx. "Death from dyspnoea was likely soon to result."	Date not given. "Removal of the right thyroid gland." Probably an enucleation of an adenoma.	Recovery.	
30	Miner, J. F., Sisters of Charity Hospital, Buffalo, N. Y. Feasibility of extirpating the thyroid gland in some cases of disease, with report of a case. Buffalo Med. & Surg. Jour., 1876-77, xvi, 323.	M. 15 yrs.	Cystic tumors of right gland. Duration eight years.	Dyspnoea.	Enucleation. No large vessels encountered.	Recovery.	Profuse bleeding from small vessels at base of tumor seared by actual cautery.
31	*Idem.* Wall, C. A., Removal of the thyroid gland. Buffalo Med. & Surg. Jour., 1877-78, xvii, 207.	M. 42 yrs.	Large calcified and cystic adenoma of isthmus. Duration 23 years.	Slight suffocation at night.	Oct. 25, ——. Enucleation. The inferior thyroid arteries were ligated and divided.	Recovery.	Extirpation of tumor composed of cysts and calcified masses, measured 9 inches in circumference, 3¾ inches in breadth, 4 inches in length, 2½ inches in thickness. The ligatures of silk were left long.
32	Fuller, Wm. Successful removal of right lobe of thyroid gland by the knife. Detroit Lancet, 1878, i, 883.	F. 40 yrs.	Tumor, size of an orange, right lobe.	Neuralgia in back of neck, shoulder and head; tingling sensation in the arms and hand.	April, 1878. Excision-enucleation of right lobe—partly substernal. Superior thyroid artery accidentally torn and secured with difficulty.	Recovery.	"The wound was closed when suppuration was fully established, and the ligatures came away slowly during three or four weeks." Pedicle ligated with waxed cobbler's thread.

TABLE IV.—UNITED STATES AND CANADA.—Continued

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
33	McLean, R. A., lecturer on anatomy University of California. Two successful cases of extirpation of the thyroid gland for fibro-cystic tumors. Case I. Western Lancet, San Francisco, 1878-79, vii, 263.	F. 56 yrs.	Large "fibro-cystic tumor." Duration about 15 years.	Pain; suffocation; dysphagia.	Op. I.—Sept., 1877. Free incision into the sac; drainage until healed from bottom. Op. II.—Oct. 15, 1877. Excision of left lobe and isthmus; possibly of right lobe also.	Recovery.	A portion of the anterior wall of the pharynx and the greater cornua of the hyoid bone were cut away in course of the operation. "Branches of the inferior and superior thyroid arteries were cut and tied, but the haemorrhage was insignificant."
34	McLean, R. A., San Francisco Female Hospital. *Ibid.* Case II, p. 265.	F. 30 yrs.	Large fibro-cystic tumor. Duration 14 years.	Pain.	Jan. 16, 1878. "Enucleation of tumor. A few vessels were cut and ligated."	Recovery.	
35	Maclean, Donald, professor of surgery, University of Michigan. Cystic goitre, complicated by epilepsy. Excision of the cyst. Recovery with complete and permanent cure of the epilepsy. Physician & Surgeon, Mich., 1879, i, 9.	M. 29 yrs.	Cystic goitre, size of an orange.	Sleeplessness; epilepsy.	Cyst tapped twice. March 18, 1876. Enucleation of cyst. Profuse haemorrhage controlled by transfixion ligatures.	Recovery.	The epilepsy followed an injury of the head. Three years post operation: No return of epilepsy.
36	Devecchi, P. Contributions to the study of the radical cure of goitre. San Francisco Western Lancet, 1881, x, 241.	M. 24 yrs.	Large cystic goitre of right lobe and isthmus. Duration eight years.	Dyspnoea.	June 16, 1881. Enucleation of cyst.	Recovery.	No large blood vessels were encountered. Operation carefully performed.
37	McGraw, T. A. Operation of the thyroid gland. Detroit Clinic, 1882, i, 1.	.....	.....	.....	.....	.....	Unable to obtain the original communication.
38	Wyeth, J. A., surgeon to Mt. Sinai Hospital, New York. Some cases of goitre recently treated by excision. Med. Record, N. Y., 1882, xxi, 94.	F. 22 yrs.	Tumor of left lobe and isthmus.	.....	July, 1881. Cystic portion of tumor aspirated and injected with tincture of iodine, by Dr. Gerster. Sept. 7, 1881. Excision-enucleation. Superior and inferior thyroid arteries ligated, and finally the pedicle *en masse*.	Recovery.	Cure with aphonia, which is believed to have disappeared. The tumor was probably an adenoma with cystic centre, and enucleable.
39	Byrd, W. A., St. Mary's Hospital, Quincy, Ill. Connell, G. W., Extirpation of thyroid gland by enucleation. Med. & Surg. Reporter, Phila., 1882, xlvi, 111.	F. 3 yrs.	Tumor weighing 8 ounces. Duration one year.	Dyspnoea.	Dec. 6, 1881. Enucleation.	Recovery.	

TABLE IV.—UNITED STATES AND CANADA.—CONTINUED

No.	Operator and publication	Sex and age	Location and duration	Symptoms	Operation	Result	Remarks
40	Cheever, D. W., surgeon Boston City Hospital, Boston, Mass. Excision of the goitre. Case I. Med. & Surg. Reports, City Hosp., Boston, 1882, 3 s., p. 130.	F. 36 yrs.	Solid tumor, size of small orange, in front and to right of trachea. Duration four years.	"Great pain."	Date not given. Extirpation by blunt dissection. Pedicle transfixed, ligated; tumor was cut away and the base burned with the galvano-cautery.	Recovery.	Dr. Cheever's operative work may be regarded as typical of the best methods in America of the period. He enucleated small tumors of the thyroid, but considered removal of a large double bronchocele as "out of the question," although in 1865 he apparently removed the entire gland. *Vid.* case No. 12.
41	*Idem.* Case II, p. 131.	F. 23 yrs.	Solid tumor, size of lemon, to right of midline, and small one, correspondingly situated, on left side. Duration two years.	.....	Dec. 14, ——. Extirpation by blunt dissection. Transfixion ligatures of pedicle, tumor cut away, and base burned with the galvano-cautery.	Recovery.	Wound dressed with carbolized oil and syringed daily.
42	*Idem.* Case III, p. 133.	"Young girl."	Small circumscribed tumor of "one lobe."	.....	Date not given. The tumor "was removed without haemorrhage." No particulars.	Recovery.	Described in only three lines.
43	*Idem.* Case IV, p. 133.	"Young lady."	Bronchocele. Small circumscribed tumor.	.....	Date not given. Tumor "removed without trouble."	Recovery.	A four-line description.
44	McIntyre, J. H. Reported by Watkins, W. W., St. Louis, Mo. A partial extirpation of a remarkably large bronchocele. St. Louis Med. & Surg. Jour., 1883, xlv, 409.	M. 29 yrs.	General enlargement of thyroid gland. Duration nearly eight years.	"Impeded cerebral circulation"; eyes somewhat prominent; mental anxiety.	May 10, 1883. Left lobe removed by "the tear-process or enucleation." Left superior thyroid artery torn through near its origin. Operator unable to determine whether inferior thyroid artery had been divided or not.	Recovery.	Probably a mild case of Graves' disease. Three months post operation: The remaining portion of the gland (the pyramid and right lobe) had decreased one-third and the cerebral symptoms had nearly disappeared. Crude operation.
45	Wyeth, J. A., surgeon to Mt. Sinai Hospital, New York. Goitre. Excision. Cure. Med. Record, New York, 1883, xxiv, 566.	F. 16 yrs.	Circumscribed tumor of right thyroid lobe. Duration four years.	.....	Oct. 10, 1883. Excision-enucleation. Superior and inferior thyroid arteries ligated, and finally the pedicle *en masse*.	Recovery.	The remains of the right lobe probably removed, as well as the tumor.

TABLE V.—GERMANY, AUSTRIA AND SWITZERLAND

Author and publication	Number of cases
Hildanus, Fabric. (1596)	1
Hildanus, Fabric., ii, 399; Hildanus, F., Opera, p. 216, Obs. xxxv; Langenbeck, Chirurgie, Bd. v, 306. (Ref., Günther.)	
Vogel, A. F.	1
Observations quaedam chirurgicae defendit, Kiliae, 1771. (Ref., Günther.)	
Freitag, J. H. (about 1694)	1
Epistola de glandulae thyroideae, partim osseae, partim meliceridis fromam referentis Extirpatione, Lipsiae, 1778; Weiz, Neue Auszüge aus Dissert. f. Wundärzte, Bd. iv, 66; Langenbeck, Chir., Bd. v, 304. (Ref., Günther.)	
Eichenberg	1
Epheremid. med. physic. germ. acad. Natur. curios. Dec. ii. Ann. v, 453; Langenbeck, Chirurgie, Bd. v, 304. Anm. (Ref., Günther.)	
Kergel, Saxony (about 1800)	1
Bernstein, J. G., Praktisches Handbuch f. Wundärzte, Leipzig, 1800, N. Aufl., Th. iii, 604.	
v. Walther, Ph.	1
Neue Heilart des Kropfes durch die Unterbindung der oberen Schilddrüsenschlagadern, u. s. w., Sulzbach, 1817. (Ref., Chelius, M. J.)	
v. Klein, Stuttgart	3
Jour. d. Chir. u. Augen-Heilk., Berlin, 1820, i, 106.	
Zang	1
Höring, Rust's Magazin f. d. gesammte Heilk., Berlin, 1820, vii, 314.	
Hedenus, J. A. W., Dresden (about 1800)	6
Jour. d. Chir. u. Augen-Heilk., Berlin, 1821, ii, 237.	
v. Walther, Ph.	1
Jour. d. Chir. u. Augen-Heilk., Berlin, 1821, ii, 584.	
Fritze, Cl.	1
Hedenus, A. G., Tractatus de glandula thyreoidea, Lipsiae, 1822, 256, footnote 612.	
Gräfe, Berlin (1820)	3
Hedenus, A. G., Tractatus de glandula thyreoidea, Lipsiae, 1822, 255, 276, 292.	
Ohle, Dresden	1
Hedenus, A. G., Tractatus de glandula thyreoidea, Lipsiae, 1822, 291.	
Weiss, Dresden	1
Hedenus, A. G., Tractatus de glandula thyreoidea, Lipsiae, 1822, 291.	
Wedemeyer	1
Neue Bibliothek f. d. Chir. u. Ophthalmologie (Langenbeck), Göttingen, 1822, iii, 185.	
Schmidt, H., Paderborn	1
Zartman, De strumae extirpatione, Dissert., Bonn., 1829, 26. (Ref., Günther.)	
v. Walther, Ph.	2
Zartmann, De strumae extirpatione, Dissert., Bonn., 1829, 22 and 26. (Ref., Günther.)	
Mandt, Greifswald (about 1832)	1
Rust's Magazin f. d. gesammte Heilk., Berlin, 1832, xxxvii, 387.	

Author and publication	Number of cases
Langenbeck, Göttingen	1
Langenbeck's Chirurgie, 1834, v, 303.	
Madelung, Gotha (1844-46)	1
Schmidt's Jahrb., Leipzig, 1847, lvi, 279.	
Dieffenbach, J. F., Leipzig	1
Dieffenbach, Die Operative Chirurgie, Leipzig, 1848, ii, 331.	
Pirogoff, N.	1
Rapport médical d'un voyage en Caucase, St. Pétersbourgh, 1849; Schmidt's Jahrb., 1850, lxvii, 116. (Ref., Günther.)	
Schuh, Wien	3
Wien. med. Wochenschr., 1859, ix, 641 and 657.	
Klein, A.	1
Dissert., Tübingen, 1860, 30.	
Schuh, Wien	1
Wien. med. Wochenschr., 1860, x, 145.	
Meeh, Brackenheim	4
Med. Corresp.-Bl. d. württemb. ärztl. Vereins, Stuttgart, 1861, xxxi, 227.	
Name of operator not given	2
Deutsche Clin., 1861, 167. (Ref., Günther.)	
Middeldorpf, P., Breslau	1
Lebert, Krankheiten der Schilddrüse, Breslau, 1862, 220.	
Franke, Leipzig (about 1834)	1
Günther, G. B., Lehre v. d. blutigen Operationen am menschlichen Körper, Leipzig u. Heidelb., 1864, 369.	
Bovet, A.	1
Gaz. des hôp., Paris, 1865, xxxviii, 105.	
Sick, P., Stuttgart	1
Med. Corresp.-Bl. d. württemb. ärztl. Vereins, Stuttgart, 1867, xxxvii, 199.	
Gärtner, Stuttgart	1
Med. Corresp.-Bl. d. württemb. ärztl. Vereins, Stuttgart, 1867, xxxvii, 303.	
Hofmockl	2
Wien. med. Presse, 1869, x, 39, 64, 90.	
Emmert, Bern	3
Brière, V., Inaug. Dissert., Lausanne, 1871, 40, 41, 42.	
Hopmann, Köln	1
Deutsche Zeitschr. f. Chir., Leipzig, 1873, ii, 185.	
Lücke, A., Bern (1865-72)	10
Deutsche Zeitschr. f. Chir., Leipzig, 1873, ii, 337.	
v. Chelius, F., Dresden	5
Jahresb. d. Gesellschaft f. Natur- und Heilk., Dresden, 1874, 13.	
Kappeler, O., Münsterlingen	28
Chir. Beobachtungen aus dem Thurgauischen Kantonsspital Münsterlingen, 1865-70, Frauenfeld, 1874, 99 (five cases). Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 314 (1868-1882, 28 cases).	
Gärtner, Stuttgart	3
Med. Corresp.-Bl. d. württemb. ärztl. Vereins, Stuttgart, 1876, xlvi, 233.	

Author and publication	Number of cases
Küster, E., Berlin (1875)	1
Bruberger, Deutsche Mil. ärztl. Zeitschr., Berlin, 1876, v, 453.	
v. Bruns, V., Tübingen (1851-70)	28
Süskind, Inaug.-Abhandl., Tübingen, 1877.	
Rose, E. (1878)	5
Arch. f. klin. Chir., Berlin, 1878, xxii, 1.	
Billroth, Th. (1860-81)	84
Wölfler, A., Wien. med. Wochenschr., 1882, xxxii, 5.	
Martin	1
Rev. méd. de la Suisse romande, Genève, 1882, ii, 590.	
v. Riedel	1
Wien. med. Wochenschr., 1882 xxxii, 1109	
Kocher, Th., Bern (1872-83)	102
Arch. f. klin. Chir., Berlin, 1883, xxix, 300.	
v. Bruns, V. and P., Tübingen (1877-81)	14
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 317.	
Kuhn, St. Gallen (1878-80)	8
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 318.	
Czerny, Heidelberg (1872-81)	11
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 319.	
Maas, Freiburg i. B. (1878-81)	10
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 320.	
Kottmann, A., Solothurn (1879-81)	9
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 321.	
Bircher, Aarau	5
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 328.	
Kaufmann, Zürich (1880-81)	3
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 329.	
Niehans, P., Bern (1880-81)	3
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 329.	
Baumgärtner, Baden-Baden	2
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 329.	
Borel, F., Neuchâtel (1877-82)	15
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 330.	
Haffter, Frauenfeld (1881-82)	4
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 333.	
Courvoisier, Riehen (1881)	2
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 334.	
Berney, A., Rolle (1855)	1
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 335.	
Emmert	2
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	
Krebs	3
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	
Gussenbauer	11
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	

Author and publication	Number of cases
Albert	9
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	
Boéchat	1
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	
Schläpfer (1881)	1
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255.	
v. Muralt, W., Zürich	108
Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 255, footnote.	
Julliard, G.	31
Revue de chirurgie, Paris, 1883, iii, 585.	
Total	575

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9. *Idem:* Asportazione di gozzo parenchimatoso con esito felice. *Ibid.*, p. 209.
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13. Baumgärtner: Ueber Kropfexstirpationen. Tageblatt der 54. Versammlung deutscher Naturforscher und Aerzte zu Salzburg, 1881 (vom 18. bis 24. Sept., 1881), p. 145.
14. *Idem:* Kocher, Th., Arch. f. klin. Chir., Berlin, 1883, xxix, 329.
15. *Idem:* Zur Cachexia strumipriva. Arch. f. klin. Chir., Berlin, 1885, xxxi, 119.
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17. Beauregard: Delens, Bull. et mém. soc. chir., Paris, 1883, n. s., ix, 21.
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29. *Idem:* Wölfler, A., Wien. med. Wochenschr., 1879, xxix, 733, 758, 782, 810, 831.
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SURGERY OF THE BILIARY TRACT
AND
PANCREAS

REMARKS CONCERNING GALL-STONES AND BILIARY SURGERY[1]

Dr. Lange's talk has been very instructive to all of us. At one of our meetings, not very long ago, I described three consecutive choledochotomies or incisions into the common duct for the removal of gall-stones, all of which were successful. Two of these cases I exhibited on that occasion. What Dr. Lange says about the enlargement of the head of the pancreas interests me, because on several occasions I too have noticed in gall-stone cases that the pancreas was hard. On the first occasion, some four or more years ago, I was misled and thought for a time that the patient might have cancer of the pancreas. Since then I have several times found an indurated pancreas in these cases and have spoken of it at the operating table. The induration of the head of the pancreas was especially noticeable in one case. This case was one of great interest irrespective of this hardening. A very large stone occupied and had almost ulcerated through the common duct. There was, however, no local peritonitis. A little scratch and a little pressure on the wall of the common duct were enough to extrude the stone. The stone being extracted, we found quite a large hole in the common duct and duodenum just where they came together. This made a plastic operation necessary; and a very difficult one it proved to be because we had to do such delicate work at such a very great depth. Even if the parts to be stitched could have been brought to the surface it would have been no easy task to accomplish the repair of the hole. The patient made an excellent recovery. She has gained nearly *one hundred pounds* and has no symptoms of stricture of the ductus choledochus. Of the other cases of stone in the common duct, one is interesting because complete obstruction was caused by a very small stone in the diverticulum of Vater, or near it. This stone, not more than 3 mm. in diameter, could not be pushed in either direction. After considerable manipulation we cut down upon it and removed it. It will undoubtedly strike you as very strange that we could not manage to extrude so small a stone. We might possibly have succeeded with the exercise of some violence; but the choledochotomy recommended itself to me as the safer procedure. We might, with a hypodermic syringe, inject oil into the duct and so perhaps make smooth the folds of mucous membrane and dislodge the stone by subsequent manipulation.

[1] Remarks in discussion of Dr. F. Lange's paper, "The Surgical Significance of Gall-stones." The Johns Hopkins Hospital Medical Society, Baltimore, October 19, 1896. Johns Hopkins Hosp. Bull., Balt., 1897, viii, 31.

Regarding death from haemorrhage: Dr. Lange speaks of the so-called parenchymatous haemorrhage in these highly jaundiced patients. We have had one death from this cause. Our first common duct case died on the tenth day from haemorrhage. There were absolutely no symptoms of peritonitis. The patient made a very good recovery from the operation, notwithstanding the fact that he was so weak that we hesitated to operate upon him.

In 1880 or 1881 I performed my first gall-stone operation. At that time only one or two operations for gall-stones had been performed in this country. The case is one of considerable interest. Seven stones were removed from the bladder, which was distended with pus and adherent to the abdominal wall. The common duct could not with safety have been examined even if it had occurred to me to do so. The patient lived for about two years after the operation. At no time after the operation was she entirely free from jaundice, nor was she at any time either before or after the operation profoundly jaundiced. The stools were usually acholic, but occasionally showed unmistakable signs of bile. The sinus which led to the gall-bladder was not allowed to close until a few weeks before the death of the patient. Death was precipitated by a slight local peritonitis. At the autopsy all signs of the sinus which had led to the gall-bladder had disappeared. Nothing but a few connective tissue threads remained to indicate where the sinus had probably been. The gall-bladder was reduced to nothing but a little knob of connective tissue. The liver was perhaps less than one-half its original size. The common duct and one hepatic duct were dilated sufficiently to permit a calculus as large as a plover's egg to glide easily up and down from the duodenum to the interior of the liver. The calculus was somewhat egg-shaped, and could almost be pushed into the duodenum through the opening which partly by ulceration, partly by dilation, it had made for itself. It became engaged at this ring of cicatricial tissue a little beyond its middle when allowed to fall naturally, point downwards, in the common duct, from the liver to the duodenum. The wall of the common duct was very thick. The stone had evidently freely traversed the entire length of this dilated canal, from the very centre of the liver to, and almost into, the intestine. At the autopsy, which was made by a very distinguished pathologist, the calculus was not found until the liver had been literally cut to pieces, so deeply was the stone imbedded in this organ. The occasional presence of bile in the stools and the absence of profound jaundice were thus readily explained by the findings at the autopsy. When the calculus was in the dilated branch of the hepatic duct, bile could escape through its other branch and appear in the faeces. When the calculus plugged tightly the orifice into the duodenum, the jaundice increased. That it

should never have been profound could be explained by the fact that the stone traveled freely everywhere in the duct; a little bile could probably escape except when the stone was engaged at the duodenal end of the duct.

Will Dr. Lange kindly tell us if he always employs drainage of some kind in suture of the ductus choledochus; and if so, how long does he permit his drain to remain? Does he not think that the drainage material, gauze, etc., should be left undisturbed until the rest of the peritonaeal cavity is well walled off and protected from reinfection? Quite recently one of Germany's best surgeons removed the gauze in one of these cases on the third day. Peritonitis supervened promptly and the patient died. I have noted that this surgeon and several well-known English surgeons state that no harm is done by leakage from the duct after suture of it, provided one drains down to the sutures. I think that one should, if possible, so suture the duct that its contents cannot escape. Fluid can convey solid and infected particles to places in the general peritonaeal cavity which are not protected by the gauze. Furthermore, I have the idea that adhesions take place more firmly about dry gauze than about gauze which is constantly bathed in fluids.

For this reason, if we have sutured a gall-bladder to the parietal peritonaeum, or if we have packed gauze anywhere about this gall-bladder which we have opened and propose to drain, we endeavor to prevent leakage for the next three or four days by passing a purse-string suture all along the edge of our opening into the gall-bladder, and drawing it up when we have introduced our gauze or drainage tube into the gall-bladder.

We explore all the ducts and open and evacuate the gall-bladder in one act. Riedel's advice to perform the operation in two acts, opening and evacuating the gall-bladder at the second act, is bad. We have more than once, while removing biliary calculi, remarked that it would have been impossible to extract them without the aid of fingers in the abdomen. Bimanual manipulation is of course impracticable when the bladder is adherent, all around, to the abdominal wall, as it is at the time of the second act in the operation in two acts.

Dr. Lange's suggestion to cut through one or two ribs to facilitate matters where the liver is very small and the gall-bladder so high as to be otherwise almost inaccessible, is undoubtedly an excellent one.[2]

[2] Jan. 2, 1897. I have recently had occasion to resort to this procedure while removing a tuberculous kidney which was adherent to the diaphragm. After dividing two ribs I could proceed quite easily with a dissection which otherwise might not have been feasible. When the liver is very large this method of gaining room is indicated quite as much as when the liver is small.

MINIATURE HAMMERS AND THE SUTURE OF THE BILE DUCTS[1]

The surgery of the common bile duct is still in its infancy. "Suture of the thickened duct is difficult enough, and suture of the normal duct out of the question," says one. "It is not worth while to exercise such great care in sewing up a slit in the common bile duct, for it is almost impossible to prevent leakage, and a little additional leakage can do no harm if one drains," says another. "Wait until the common bile duct dilates and thickens before venturing to open it," say all surgeons.

"Ein normaler Ductus choledochus ist ein ausserordentlich dünnwandiges Gebilde; eine Längswunde in demselben exakt zu vernähen, durfte technisch ausserordentlich schwierig sein, zumal man durch Einstülpung der Wundränder leicht das Lumen des Kanales zu sehr verengen kann. Zum Glücke erweitert sich der Ductus choledochus bei Eintritt von irgendwie grösseren Steinen alsbald, seine Wandung wird dicker, so dass Incision und Naht meist leicht gelingen."[2]

"Beim dritten Act, habe ich die Schwierigkeit des Nahtverschlusses der Incision des Choledochus, welche in 2 Fällen überhaupt unmöglich war, kennen gelernt, die Nützlichkeit der Tamponnade, eingesehen, sobald die Choledochotomie für sich allein ausgeführt oder mit der Cystectomie verbunden wurde."[3] "Eine Choledochotomie rechnet er [Kümmell[4]] zu den technisch schwierigsten Operationen."[5]

To close an incision in the normal ductus communis choledochus has been considered so impracticable, not to say impossible, and the result of the suture, so far as the suture itself is concerned, even of the abnormally thickened duct so uncertain, that it is the practice of all surgeons to wait weeks or months or even years for the duct to dilate and thicken rather than interfere promptly in cases of obstruction of the common bile duct by stone.

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, December 13, 1897.

Johns Hopkins Hosp. Bull., Balt., 1898, ix, 67-69. (Reprinted.)

[2] Riedel: Chirurgische Behandlung der Gallensteinkrankheit, p. 115. Handbuch der Speciellen Therapie innerer Krankheiten, Bd. iv.

[3] Kehr: Ein Rückblick auf 209 Gallensteinlaparotomieen. Arch. für klin. Chirurgie, Bd. liii, Heft 2, p. 375.

[4] Mittheilungen aus den Hamburgischen Staatskrankenanstalten, 1897, Bd. I, Heft. 2.

[5] *Ref.* Tschmarke, Centralblatt für Chirurgie, 1898, No. 5, p. 134.

It is perhaps justifiable to "give nature a chance" to expel the stone, but the operation should never be postponed solely for the sake of giving the duct time to become thicker. I know from operations upon dogs and man that the normal bile ducts can be sutured easily, accurately, almost infallibly, and without danger of leakage or constriction.

We are all more or less acquainted with the more evident dangers of postponing choledochotomy when it is indicated; the deep jaundice, the retarded blood coagulation and the consequent danger from haemorrhage, whether an operation is performed or not; the cirrhotic hypertrophy of the liver and the concomitant haemorrhages into stomach and intestines, the acute or chronic inflammation of the bile passages; toxaemia, cholaemic or infectious, and the interference with metabolism, more serious, perhaps, in its remoter consequences than we have estimated. And when at last the operation is resorted to the patient is perhaps so weak that the surgeon might well wish that he had interfered earlier.

The duct lies in a deep hole, at a great distance from the surface, and is covered by the liver, which is usually enlarged in the cases which we are considering, and which, if very large or very small, may embarrass the operator exceedingly. The suggestion of Dr. Fred. Lange to cut through one or two ribs and the diaphragm when the liver is very large we have found invaluable. And not only when the liver is large have we profited by this hint; for once when it was small and high up under the ribs, the duct, carried up with it, was perhaps even less accessible than in the cases complicated with large liver.

Once then because of a small liver, and several times because the livers were large, have I divided ribs and diaphragm, and each time with gratifying results. When operating upon the bile passages of dogs I divide two or three ribs and the underlying diaphragm as a matter of routine. Cutting through a few ribs and the diaphragm on the left side enabled me to remove a large and very adherent tuberculous kidney.

With the little hammers which I am describing, or with a similar contrivance, I have five times sutured the common bile duct in dogs, and twice the common duct and once the cystic duct in the human subject. Two of the dogs referred to were operated upon last spring and observed during the summer and part of the autumn.

Dog 1.—*June 24, 1897:* Long incision in common bile duct sutured over an aluminum rod with six mattress sutures of fine black silk. The wall of the duct was so thin that all of the stitches necessarily penetrated it. The silk itself was thicker than the wall. I intentionally turned in a great deal of the wall, wishing to temporarily occlude the lumen of the duct; and having withdrawn the rod and tied the sutures, I was impressed with the

thread-like appearance of the duct and thought that I had perhaps totally occluded it. The dog was apparently as well as usual in a day or two and was observed all summer. At no time was he jaundiced, nor did he seem to be in the least inconvenienced by the operation.

October 1st.—Dog killed with ether. Autopsy. Except for the few silk threads in the tissues there was little to evidence the operation.

Dog 2.—*June 24, 1897:* Through an incision into the ductus communis choledochus a small shot not quite large enough to occlude the lumen of the duct was introduced. The duct was sutured with mattress sutures over an aluminum rod as in the preceding case.

The aluminum rods, of several sizes, were flexible and were bent to suit the case just before using. I was very much pleased with the rods, because they made not only possible but very easy what hitherto had been considered too difficult to attempt. The rods suggested to me the rubber bags for intestinal suture which I have already described.[6]

The little hammers which I now use answer the purpose better than the rods. Within the past three weeks I have twice used the hammers on the human subject. If properly employed they convert one of the most difficult operations in surgery into quite a simple one. The hammers are of sizes (*vid.* Plate XCVI, 1 and 2) to meet all cases, from the normal duct in a dog to a much dilated human duct.

To Use the Hammer in Suture of the Common Bile Duct

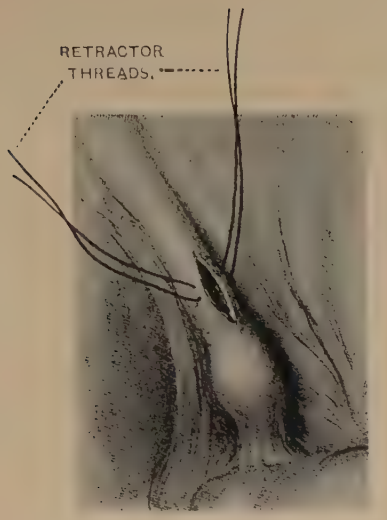
It is not necessary to dissect the duct from its bed, but the wall of the duct should be clearly exposed at the site selected for the incision. I usually incise the common bile duct near its duodenal end because the diverticulum of Vater can be more thoroughly explored through an incision at this end of the duct, and because it is easier to suture this end than the other or cystic end of the common bile duct.

Before incising the duct, two presection stitches, to serve as retractors, should be taken. These stitches, which are subsequently removed, should enter the lumen of the duct. They are placed close together and the incision into the lumen of the duct is carried between them (*vid.* Plate XCV, 1).

The stone having been removed and the gall passages thoroughly searched with probe and fingers, the retractor threads are drawn apart and a hammer of the proper size introduced (*vid.* Plate XCV, 2).

The duct is then gently raised from its bed and drawn towards the operator (*vid.* Plate XCV, 3) by the hammer, the head of which is of course longer than the incision.

[6] Philadelphia Med. Journ., Jan. 8, 1898, and The Johns Hopkins Hospital Bulletin, Feb., 1898.


RETRACTOR
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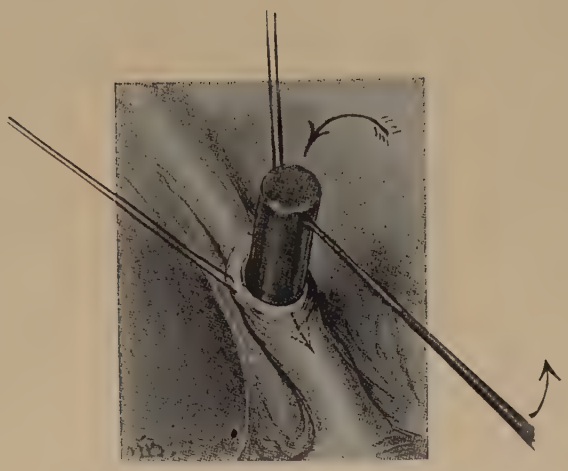

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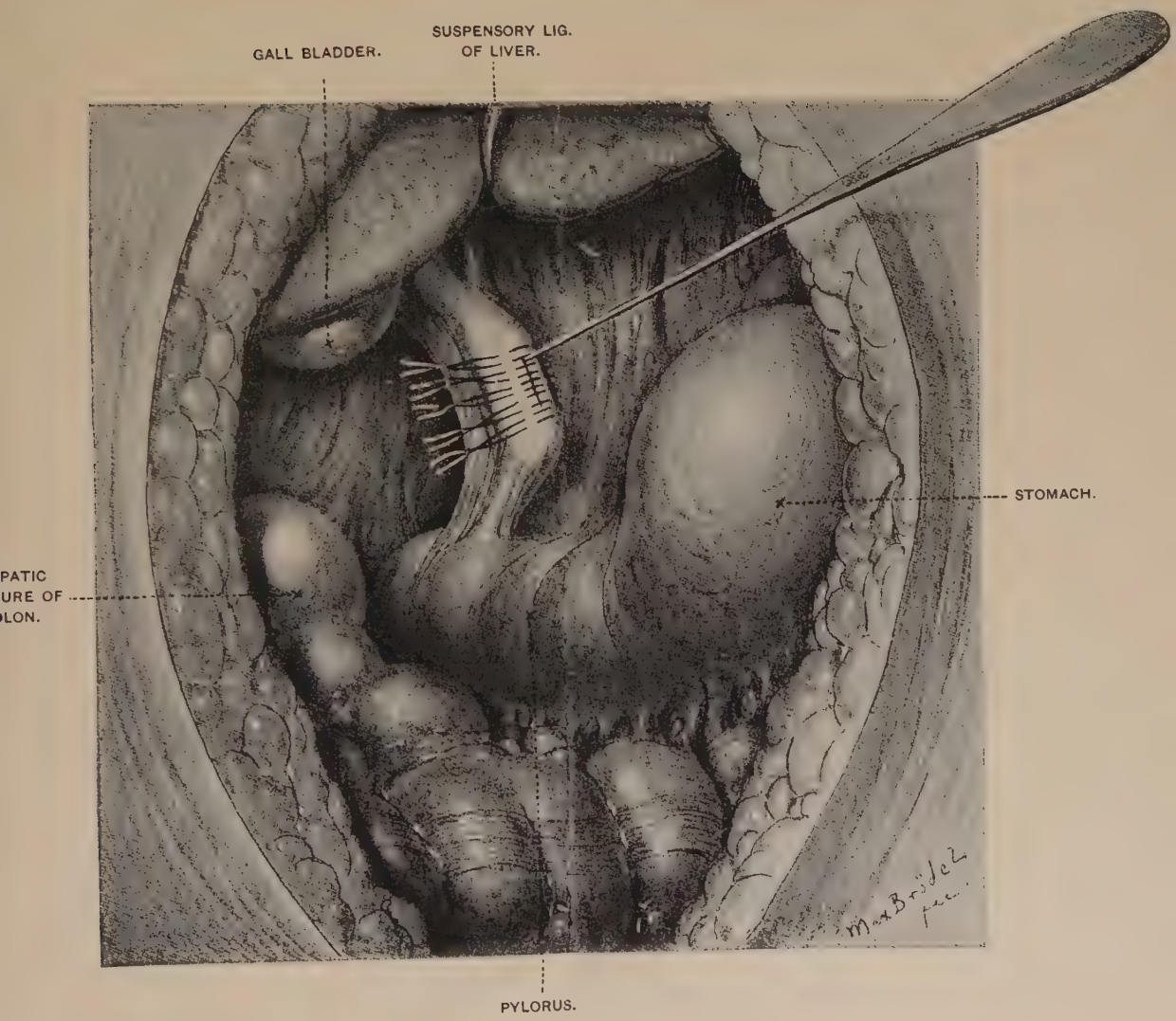
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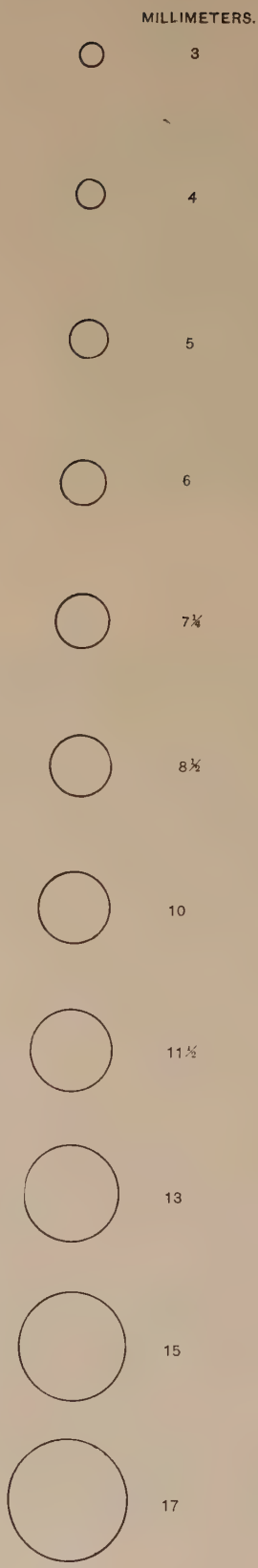


2.

Mattress stitches are then applied as shown in Plate XCV, 3; one over the heel behind the handle of the hammer, and the others in front of the very delicate handle. This beautiful drawing was made from the subject and depicts accurately the parts concerned in this stage of the operation.

Although the finest possible needles and silk are used, the stitches necessarily perforate the wall of the normal duct. No harm results from this perforation, however, for the normal duct practically always and the thickened duct usually is sterile, and the stitches very soon cut their way out of the lumen and out of the wall of the duct and lie free in the adventitious tissues.

The silk which we use is very much finer than the artist supposed when he made the drawings, and the needles, made for us by Wülfing-Luer, of Paris, have a split eye and are almost as fine as the silk itself. One should have a needle-holder especially made and reserved for these needles. If such a needle-holder is used for coarser work it will soon be ruined.

I have been asked why the handle is not placed in the middle of the hammer. It is placed as near one end as practicable, to enable the operator to introduce the hammer through as small an incision as possible, an incision not longer than about half the circumference of the hammer.

The Advantages of the Hammer

1. The duct to be sutured can be drawn towards the incision in the anterior abdominal wall and within easy reach of the operator; it can also be manipulated nicely by the hammer.

2. The duct, whether normal or thickened and dilated, is gently expanded by the hammer; hence the stitches can be taken with great accuracy and without fear of including the opposite wall or of occluding the lumen of the duct.

3. The operation is a very clean one, because the hammer blocks the duct and this prevents the escape of its contents and the contents of the gall bladder.

4. With the hammer, wounds of thin normal ducts can be easily and almost infallibly sutured, and hence the surgeon may, if he chooses, fearlessly operate upon the common duct as soon as the obstruction takes place.

The sewing of the thickened and dilated ducts is also greatly facilitated by the employment of the hammer.

CONTRIBUTIONS TO THE SURGERY OF THE BILE PASSAGES, ESPECIALLY OF THE COMMON BILE-DUCT[1]

Just now I am very much impressed with the splendid results of operations for gall-stones in the common duct, for we have had of late a series of cases very desperately ill, and so transformed by their emaciation and discoloration, and so feeble in body and mind, that I could hardly picture to myself the various stages of metamorphosis toward convalescence. Every one has seen a patient whose life has been despaired of convalesce from acute disease; they watched his rapid decline and expected an almost equally rapid recovery; but when the decline has covered a period of five or 10 or perhaps 20 years the changes wrought are so great and apparently of such permanent character that the complete restoration to health is the more astonishing. The large cirrhotic liver, the dry slate-yellow skin, the enfeebled intellect, the body emaciated to the last degree, seem at times almost to preclude all hopes of recovery to the practitioner who has not witnessed the changes so quickly brought about by nature as soon as the mechanical obstacles to recovery have been removed by the surgeon. What nature accomplishes without the surgeon's aid in her attempts to rid herself of the obstruction in the gall-passages and to repair self-inflicted damage is marvelous; but her methods are very crude and attended with much suffering and great danger, immediate and remote. I have, however, in mind at this moment two particularly creditable examples of nature's surgery.

In the first one the gall-passages were shortened to just the length of the two large stones which completely filled them. One occupied the gall-bladder, the other the pancreatic portion of the common duct; the duodenum was not only adherent to the gall-bladder, but served in place of its anterior wall, which had been destroyed; the stone in the gall-bladder, therefore, rested on the wall of the duodenum, which was pasted, so to speak, over the great hole in the front wall of the bladder. There was nothing that could be called cystic duct; the choledochus was almost completely covered by the duodenum; the hepatic duct was much distended, admitting easily one finger. All signs of inflammation, except its results, had disappeared. The simplest conditions had been produced, and those most favor-

[1] Read before the Surgical Section of the Suffolk District Medical Society, Boston, May 3, 1899.

Boston M. & S. J., Boston, 1899, cxli, 645-654; discussion, 661-664.

Also: Johns Hopkins Hosp. Bull., Balt., 1900, xi, 1-11. (Reprinted.)

able to the expulsion of the stones in some subsequent attack; gall-bladder and common duct were reduced to a short, wide, nearly straight tube, which bore a striking resemblance to an atheromatous aorta. The stone in the common duct was behind the duodenum and buried in its wall.

The second patient had his first colic 21 years before admission to the hospital. He was never jaundiced. In the third attack, which began one month prior to operation, his temperature reached 106°. A physician aspirated pus from the distended gall-bladder about 24 days after the onset of the third attack, or three or four days before we operated. The gall-bladder was opened in two acts. The fluid in the gall-bladder was almost clear and not bile-stained. Diagnosis: Stone in the cystic duct. Cover-slips showed few bacilli. Cultures yielded *Bacillus coli communis,* pure. Patient applied for re-admission in 18 months, because he had noticed a hard body just beneath the skin in the mouth of the sinus. By simply dilating the sinus I removed four large, very dark-green, almost perfectly cylindrical stones, which were piled up upon each other in this sinus, forming a column 10 centimetres high. Nature would herself have extruded these stones which she had brought to the surface without causing the patient any discomfort.

Equally marvelous are the processes by which nature destroys all traces of her surgical handiwork. I have operated upon two cases in which perforation of the gall-passages and intestinal walls, and the expulsion of the stone, had undoubtedly occurred, but was unable in one of them to find any evidence of the perforation other than a few light and easily separable adhesions. Again, in a case of appendicitis, followed by gangrene of the greater part of the caecum and a wide preternatural anus, there were, within a year, only a few very light adhesions about a pinhole opening in the colon to tell the story. These facts are enough to make the ordinary operations for suspension of the spleen, liver, uterus, etc., seem ridiculous. Adhesions about an artificial opening fortunately never disappear. If innocent fistulae could be established, with the organs to be suspended, the problem might in a way be solved.

I wish to ask your attention tonight to a few of the unusual facts observed by us in our operations upon the bile-passages, particularly the common bile-duct. Almost every one of our common duct cases has presented us with a new fact or two which can hardly fail to interest the general practitioner, as well as those who concern themselves with the surgery of the bile-passages. To be as brief as possible, for the time is short, I will summarize at the outset some of the more noteworthy incidents observed by us in this department of surgery.

I. Dilatation of the first part of the duodenum caused by constricting adhesions; as the result, perhaps, of the dilatation, an ulcer ("distention ulcer"—Kocher) on the confines of the pylorus; the ulcer gave rise to a dissecting submucous abscess (chronic), rich in organisms because not reached by the most painstaking sterilization of the stomach. This abscess was punctured during the operation and a fatal peritonitis resulted (terminal infection), although, literally, only a drop or two escaped, and these were carefully wiped away.

II. Primary carcinoma of the duodenal papilla and diverticulum Vateri.

First operation.—Excision of portions of the duodenum (nearly its entire circumference), pancreas, common bile-duct and pancreatic duct in order to give the little growth, no larger than a pea, a wide berth; circular suture of the duodenum and transplantation of the stumps of the common duct and the pancreatic duct (Wirsung's) into the line of this suture.

Second operation.—Cholecystcysticoenterostomy by the writer's method [2] for intestinal lateral anastomosis.

III. Dynamic dilatation of the first portion of the duodenum and of the pyloric portion of the stomach, corresponding accurately to the limits of a sharply-circumscribed peritonitis; gall-stones in the gall-bladder; hydrops vesicae. Case full of interest for diagnostician. Beautiful instance of circumscribed dynamic dilatation caused by local inflammation; no adhesions.

IV. Conditions suggesting hepaticocholecystostenterostomy (hepaticocholecystostcholecystenterostomy) as a possible operation; common and cystic ducts reduced to fibrous cords; dilated hepatic duct and gall-bladder. Remarkable toxic (?) renal colic resembling closely intestinal colic, associated with anuria; colic and anuria entirely relieved by salt infusion.

V. Choledochotomy performed twice. The gall-bladder, which was shriveled at the first operation when two stones were probably in the common duct, was large and distended at the second operation when only one stone occupied the common duct (the ampulla). Haematemesis after the second operation.

VI. The densest adhesions that I have ever encountered in these operations, and probably the most difficult of my operations upon the bile passages. A small abscess in the midst of the adhesions; muscular coat of the duodenum converted into fibrous tissue; the exposed submucosa resembled gall-bladder so closely that the duodenum was aspirated and opened.

VII. Case illustrating the rapidity with which adhesions after perforation and extrusion of stone can be absorbed. Renal pains resembling intestinal colic (third observation of the kind within 18 months). Tachycardia, believed to be due to toxaemia of some kind (possibly benign embolism),

[2] Bulletin of The Johns Hopkins Hospital, No. 10, 1891.

suddenly disappeared during counting of pulse and while preparations were being made for subcutaneous infusion.

VIII. Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later, adhesions so extensive and so dense that the common duct was reached by a retroperitonaeal route, over the right kidney. A stone in the ampulla had just ulcerated through the wall of the common duct and through its duodenal coverings.

CASE I.—*Duodenal stenosis from gall-stones; dilatation of the stomach and of the pyloric end of the duodenum; duodenal ulcer giving rise to a dissecting abscess.*—J. S., age 36, admitted February 5, 1899. Never had typhoid fever. Had malarial fever 10 years ago with shaking chills. Never suffered from stomach trouble until present illness. Ever since he was eight years old has had sick headaches, lasting three to four hours, once a month; these would be relieved by emptying his stomach. Has never been jaundiced nor had clay-colored stools. Present illness began very gradually. Three years ago he noticed that his stomach would swell after eating and hardly regain its normal size before the next meal. Had more or less pain in the epigastrium, which was most marked about one hour after eating. No nausea or vomiting at first; bowels regular. About the first of last October the pain became worse, and his sick headaches were more numerous and more severe. His vomiting now began. The vomiting was accompanied by colic, so severe as to double him up. Patient was obliged to stop work for two weeks. He then resumed work until Christmas, since which time he has been unable to work. Patient now vomits much more frequently. The vomiting is preceded by heartburn for about three hours and much pain in the epigastrium. Patient feels greatly relieved after the vomiting. For two weeks after Christmas he had eructations of gas; none since then. Bowels usually constipated; sometimes did not move for three weeks. He still suffers much from headache. His appetite is good, but he is afraid to eat. In October, 1898, patient weighed 145 pounds; he now weighs 123 pounds, and is very weak. Neither stools nor vomitus have ever been blood-stained. Urine normal. Stools clay-colored. Patient not jaundiced.

On palpation of the abdomen no distinct tumor can be felt, but one detects an increased resistance just to the right of the umbilicus. The stomach's longest diameter is 31 cm.; its shortest diameter, 21 cm. The lowest limit of the stomach (tympanitic) is 3½ cm. below the umbilicus. Spleen not palpable. Heart and lungs normal. Glands nowhere enlarged. Pulse slow, feeble, 60 beats to the minute.

January 24th.—Test breakfast (Ewald). Two hundred and sixty c. c. removed one hour later; green color; acid. Total acidity, 5.9 c. c.; 0.1 normal NaOH. Free hydrochloric acid; no lactic acid. No sarcinae nor Oppler-Boas bacilli.

February 4th.—Test breakfast. Sixty c. c. removed. Total acidity, 20. No hydrochloric acid; no lactic acid. A few Oppler-Boas bacilli (?).

February 5th.—Stomach tympanitic. Clapatage readily obtained. Stomach peristalsis quite marked at times. Gurgling felt over small intestines. Stomach washing with sterile salt solution, as preparation for opera-

tion, begun. Stomach holds about two liters. Cover slip preparations show streptococci and staphylococci and numerous bacilli.

February 7th.—Stomach washing continued. Cultures taken from the residual material. Cover slips show only a few streptococci in short chains; number much decreased since February 5th.

February 8th.—Only a trace of free hydrochloric acid; no lactic acid. Total acidity, 6.2 c. c., 0.1 NaOH solution. Stomach peristalsis readily seen at times. Patient has been kept on sterile diet ever since his transfer to the surgical side. Has carbolic-acid gargle three times daily. Teeth cleansed three times daily with listerine and brush. Ingesta are boiled water, boiled milk, soft-boiled eggs, albumin. Microorganisms seem to have entirely disappeared from the stomach, for the Petri plates are now sterile. Patient has shown great irregularity in amount of hydrochloric acid—at one time 5 per cent, at another zero.

February 9th.—Operation: Vertical incision through left rectus. This incision was made with the expectation of a possible gastroenterostomy. Stomach much dilated. In the region of the gall-bladder is a mass of tissue tangled by dense adhesions. In this mass are gall-bladder and pylorus. The mass feels not unlike a new growth. Search for metastases negative, but a small, hard, dark tumor, the size of a pea, is discovered in the right lobe of the liver, near its edge, evidently an angiosarcoma. Pylorus separated from gall-bladder with the greatest difficulty. The separation had to be effected with the knife. It was impossible at first to determine accurately the relations of the gall-bladder, pylorus and duodenum to each other. In the course of the dissection a pinhole opening was made in what proved to be the duodenum. The surrounding parts had been well protected against such an accident. A drop of fluid escaped, and from these cultures were taken. The little hole was immediately sutured. The gall-bladder was next opened, and not until then could it be determined positively that the pinhole opening was not in the gall-bladder, the contents of duodenum and gall-bladder so closely resembled each other; it was a thick, ropy, mucoid, colorless material. The gall-bladder was finally completely isolated. It was small and misshapen and contained two or three hard mulberry-like gallstones. The cystic duct contained no stones and seemed to be very short and very fine. It was surrounded by numerous small vessels, two of which were tied. There was no bile in the freely opened gall-bladder, which was drained in the usual way with a rubber tube, a catgut purse-string suture sealing the bladder hermetically about the tube. Bismuth gauze was packed about the outside of the gall-bladder. The peritonaeum was closed with silk; the muscles, fascia and skin with silver. Patient bore the operation very well. At 6 p. m., temperature 101°; respirations quiet and regular. Some distention of upper abdomen.

February 10th.—Patient has been vomiting. Complains of pains in stomach and tightness across abdomen. Pulse 108 and feeble; respirations 24; temperature 101°. Leucocytes at 12.30 p. m., 26,800; at 1.30 p. m., 34,000; 5.30 p. m., 36,000; 7 p. m., 37,800. At 6 p. m. patient drowsy, quiet; respirations, 34; hands cold; pulse barely perceptible. Coverslips show no microorganisms in the blood. Five hundred c. c. salt solution infused under each breast. At 10 p. m. 1000 c. c. salt solution infused under breasts. Pulse improved, 140 to minute; low tension but regular rhythm. Respirations 36;

expirations accompanied by short groans. Occasional hiccough; no vomiting; no nausea; no pain.

February 11th.—2.15 a. m., patient died quietly.

Autopsy.—General peritonitis. Organisms, streptococcus pure. In the walls of the first portion of the duodenum, very near the pylorus, was an accumulation of thin mucopurulent fluid. This was held in bounds by a soft wall of granulations; it was evidently an old abscess between mucosa and submucosa, which communicated with the lumen of the duodenum by a fine opening. A minute ulcer had perhaps been the starting point.

The first portion of the duodenum was distended, and the stomach was dilated; the distention was due to the constriction produced by the adhesions, for which the gall-stones were responsible; as a consequence, perhaps, of the distention and the resulting venous stasis, a minute duodenal ulcer; and from the ulcer, the abscess, which was probably responsible for the fatal streptococcus peritonitis.

Of special interest in this case is: (1) the fact that carcinoma had been suspected—the duodenal stenosis, the dilatation of the stomach, the presence of Oppler-Boas bacilli (?) justified the suspicion; (2) the success which attended Dr. Cushing's efforts to sterilize the stomach; the microorganisms had apparently entirely disappeared from the stomach on the day preceding the operation, for the Petri plates, which from day to day showed fewer colonies, for that day were sterile; (3) the dissecting intramural abscess, starting probably from an ulcer which may have been due to thrombosis of a small artery, or to distention of the first part of the duodenum, or to vascular disturbances of some kind, infectious or mechanical. Although thrombosis of a small intestinal artery does not lead to infarction, it may cause haemorrhages into the lumen of the intestine and slight intramural extravasations.[3]

Kocher[4] has demonstrated that in consequence of distention of the gut by retention of its contents and the resulting venous stasis, very considerable changes take place in the wall of the intestine. He writes as follows: "Arnd has proved that in strangulated hernias, when the circulation is greatly interfered with, microorganisms make their way into the mucous membrane and can pass through the intestinal wall (diapedesis of the microorganisms). On the other hand, Cassin[5] and Charrin[6] have shown how very important the normal epithelium of the intestine is as a protection to the intestinal wall against microorganisms as well as ferments. The absence of this protection against ferments and bacteria leads to intoxication and in-

[3] Archiv für pathol. Anat. u. Physiol., 1875.

[4] Kocher: Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie, Bd. iv, Heft 2, 1898.

[5] Mittheilungen aus Kliniken der Schweiz, Basel, 1898.

[6] Fonctions protectrices de la muquese intestinale, Soc. de biologie, December, 1895.

fection. Finally, Reichel[1] has demonstrated that the considerable accumulation of fluid above the site of the obstruction is due in part to a hypersecretion of the mucous glands. Under the influence of the intestinal contents which, increased in amount and stagnating, are the more rapidly decomposing (the ofttimes considerable phenoluria and indicanuria is proof of the increased decomposition), the epithelium in the first place becomes destroyed because its nutrition is interfered with under the influence of the venous stasis. There result circumscribed necroses and hence ulcerations of mucous membrane, particularly in places where the venous stasis led to ecchymosis, and, finally, perforation of the serosa and peritonitis may occur. For the origin of these ulcers which, many times observed, have not been properly estimated in their relations to ileus, various explanations have been given. The most substantial explanation is the one which attributes them to the pressure of hard scybala, and it is not to be doubted that hardened faecal matter, just as foreign bodies—gall-stones, for example—can have pressure ulcers as a consequence. But the ulcers which we have pictured are certainly not dependent upon hard intestinal contents and the decubitus which they may mechanically bring about. They occur in jejunum and ileum as well as in colon by the filling up of these intestines with fluid or gas. The only factor which constantly accompanies these ulcers is overdistention of the intestine. Inasmuch as one can experimentally bring about a significant impairment of the circulation of the intestinal wall and its consequences, by overstretching of the gut, we hold to the proposition that the ulcers are best called distention-ulcers (*Dehnungageschwüre*). Long ago I called attention to the fact that ulcers of just this kind could also in cases of strangulated hernia lead to a fatal peritonitis after constriction had been relieved, or a gangrenous loop of intestine had been resected and an entirely trustworthy suture had been made."

Case II.—*Primary carcinoma of the duodenal papilla and diverticulum of the Vater, successfully removed by operation; cystico-enterostomy three months after the first operation.*—Mrs. M. L., age 60. Until August, 1897, patient was well. Her first symptom was itching of the skin, which came on suddenly and soon became severe. Patient says jaundice did not appear for nearly a month after the onset of the itching. Before the appearance of jaundice diarrhoea set in, and there were six or seven stools a day which were watery and clay-colored. Patient has had no chills, no fever and no sweating. With the onset of the jaundice she noticed shortness of breath and an occasional swelling of the feet and legs. About the first of January, 1898, she had persistent bleeding of the gums for three days, following the extraction of a tooth. At times the haemorrhage was profuse. Two months ago a tumor was noticed in the region of the gall-bladder. This tumor does not seem to the patient to have increased in size and has never been tender.

[1] Zur Pathologie der Ileus, Deutsche Zeitschrift für Chirurgie.

In March, 1897, she had several attacks of severe pain in the epigastrium. These attacks were not accompanied by vomiting or fever or sweating. A few weeks later she had a second but milder attack. The stools were light in color for two or three days at the beginning of these attacks, but patient recalls no change in the color of the urine or the skin at that time. The daughter of the patient states that these attacks of pain were very severe, and that her mother seemed very ill.

Examination February 14, 1898.—Patient somewhat emaciated, but fairly well-nourished. Mucous membranes pale. Heart and lungs normal. There is a distinct prominence on the right side, the highest point of which is midway between the umbilicus and anterior superior spine. The prominence descends markedly with inspiration. On palpation the prominent area proves to be pear-shaped and distinctly fluctuating. The border of the liver, which reaches almost to the crest of the ileum, can be distinctly felt.

February 14, 1898.—Operation: Vertical incision through rectus muscle. A greatly dilated but not especially dense gall-bladder presented no adhesions. Liver projects 5 cm. below costal margin. Four silk sutures[8] placed in fundus of gall-bladder with French needles. Small aspirator introduced in center, between sutures; syringeful of clear fluid withdrawn. Gall-bladder opened; contents evacuated. In the latter part of the fluid were many fine, sand-like, hard, greenish, round particles, suggesting miniature gall-stones. Common and cystic ducts were dilated to the size of one's thumb. A longitudinal opening 2 cm. long was made in the common duct. The same colorless fluid escaped from this incision. Duct explored with probe and finger. What seems to be a small, very hard stone is felt at site of ampulla. To determine the nature of this body, an incision was made through the wall of the duodenum. No glandular metastases discoverable. The stone-like body proved to be, as was feared, a carcinoma of the papilla.

Excision of the Cancerous Growth.—To give the growth a wide margin, a large piece of duodenum was excised, a wedge-shaped piece with the apex at the mesenteric border of the intestine. About three-quarters of an inch of the common duct and a shorter piece of the pancreatic duct were excised. The wound in the duodenum was closed in the usual way with mattress sutures. This was practically an end-to-end anastomosis of the duodenum. The common duct and pancreatic duct were transplanted into the duodenum along the line of suture. A linear incision into the common duct, which had been made for diagnostic purposes, was closed over a hammer. The gall-bladder was sutured to the peritonaeum.

Abdominal wound closed in the usual way; the peritonaeum with a running silk suture, the muscles and fascia with buried silver sutures, and the skin with a continuous subcuticular silver suture. Bismuth gauze inserted to protect the suture of the intestine and common duct. Drainage tube surrounded by bismuth gauze, and gutta-percha tissue inserted into gall-bladder and held in place by a purse-string suture of catgut. Wound dressed

[8] We find this a very useful procedure. The gall-bladder is manipulated by these sutures and handling is thus avoided. These sutures are of additional service when it seems advisable to distend, subsequently, the gall-bladder with fluid, and when it is desirable to close it temporarily during the operation.

with silver foil. Gutta-percha tissue placed between the raw edges of the skin and the gauze packing. Operation lasted three hours and 10 minutes. Patient experienced apparently no shock from the operation.

February 16, 1898.—First dressing. Profuse discharge of bile in dressing. Icterus less intense. Considerable abdominal distension, but no signs of peritonitis.

February 18, 1898.—Distention has almost completely disappeared. Tongue clean. Patient comfortable.

February 22d.—Discharge of bile into dressings still profuse. Stools becoming distinctly bile-stained. Icterus rapidly disappearing. Urine dark and gives bile reaction. Patient hungry.

February 27th.—Skin sutures, tube from gall-bladder and the last of the bismuth gauze removed. Evacuations not bile-stained.

March 4th.—Discharge of bile diminishing. Opening in gall-bladder has been plugged for several days with bismuth gauze in order to determine, if possible, whether or not the transplanted common duct is patulous. Yesterday patient vomited 125 c. c. of brownish fluid.

March 5th.—Patient has had a large stool, quite dark in color. There is very little leakage from the opening into the gall-bladder, which is almost closed.

March 13th.—Icterus continues undiminished. Stools are still slightly bile-stained. Abdomen somewhat distended. Active peristalsis is occasionally visible through the abdominal walls. Liver still readily palpable, the right lobe extending almost to the iliac crest. Appetite good; tongue clean; no indigestion.

March 27th.—Attempts to plug the opening of the gall-bladder, with the hope of forcing bile into the intestine, not satisfactory, although there is some bile in the stools. Patient's general health good. Icterus has disappeared. Patient able to walk about, and is gaining strength rapidly.

April 5th.—The conjunctivae are clear, but there remains still some evidence of bile pigment in the skin. No bile whatever in the stools, although the opening into the gall-bladder is almost closed; it is barely large enough to admit a probe. Patient is beginning to have indigestion. The appetite as a rule, however, is good. The liver is diminished in size.

April 8th.—Patient complains of colic and abdominal pain. Considerable abdominal distention. Dressings bile-stained. No nausea; tongue is clear.

April 12th.—Some nausea and vomiting. No distention of abdomen. Dressings very slightly bile-stained.

April 15th.—Abdomen soft and relaxed, but borborygmi heard by attendant and appreciated by patient. Little or no bile in dressings.

May 5th.—Second operation: cholycystduodenostomy, or cysticoduodenostomy.—Suture of fundus of gall-bladder. Complete closure of abdominal wound except for drainage. Incision alongside of old cicatrix, circumscribing fistula. Gall-bladder quite small, no larger than one's thumb. Liver about normal in size. Many fine adhesions about gall-bladder, which were easily separated. Gall-bladder and ducts thoroughly exposed. The line of suture of common duct at previous operation was readily distinguishable by black-silk stitches, but it was almost impossible to find any trace of the duodenal suture. Common duct incised at site of old suture. Probe cannot be passed into the duodenum, but there is no positive evidence

of the recurrence of the cancer. Unsuccessful attempts had been made before the operation to pass a probe from the gall-bladder through the common duct into the duodenum. Opening into the common duct closed in the usual way with mattress sutures over hammer. An anastomosis between duodenum and the gall-bladder or cystic duct was effected without much difficulty, although the parts to be sutured were very deeply situated and inaccessible. The duodenum was probably a little less freely movable than at the previous operation, and the gall-bladder was so much reduced in size that we were compelled to pass some of the stitches into what seemed to be the cystic duct; in any event, the neck of the gall-bladder had to be used for the anastomosis. A *bougie à boule,* passed into the gall-bladder, was used as a darning ball to assist in the placing of the sutures. All the sutures were passed (none of them tied) before the openings into the neck of the gall-bladder and duodenum were made, the method employed being that which I described many years ago for intestinal anastomosis. The opening in the fundus of the gall-bladder was closed with mattress sutures which inverted the wall. The abdominal wound was completely closed except for protective wicks which were passed through this line of suture into the gall-bladder. What seemed to be an enlarged gland was palpated during the operation but not removed; it was forgotten. Patient suffered little or no shock from the operation.

May 6th.—4.30 p. m., patient very restless, tossing about and occasionally vomiting. Ten p. m., has had occasional quiet naps and is more comfortable.

May 7th.—Complains of pain in back and abdomen.

May 8th.—Is very comfortable. Yellow stool, containing small particles of brown faecal matter.

May 9th.—Large greenish-yellow stool.

May 11th.—Patient has had daily, since last note, one or two greenish-yellow soft stools. She still complains of slight pain in abdomen.

May 12th.—A large, quite well-formed greenish-brown stool. Considerable flatus expelled; complains of gas in stomach. Slight nausea. Four p. m., vomited thick, mucus-like, chocolate-colored fluid containing milky curd.

May 29th.—Patient complains of itching in the hands where the pruritus has always been the greatest when icterus was pronounced. No jaundice, however, is apparent.

June 8th.—Slight chill, followed by rise of temperature to 39°. Trace of bile in the urine. Nausea, but no vomiting. No pain and scarcely any tenderness of the abdomen. Wound almost completely closed.

June 9th.—Temperature normal; patient feels well.

In the early autumn of 1898 this patient returned to the hospital too ill for operative interference, and in a few weeks died. During the summer I had corresponded with her, urging her to return to the hospital, for it was clear from her letters that the fistulous communication between the gall-bladder and the duodenum was not working well. At the autopsy it was found that the carcinoma had recurred in the head of the pancreas and duodenum closing the common duct and interfering with the perfect action of the cholecystenterostomy, or cystico-enterostomy. The anastomosis, as

we had supposed, had been made between the dilated cystic duct and the duodenum; the fistula was still perfectly pervious and should have acted nicely except for the interference, a little twisting or bending, created by the new growth.

The result in this case is not encouraging, for it was my opinion at the time of the operation that the case could not have been more favorable. But I did in this case what I never do if it can be avoided, namely, cut well down to or perhaps a little way into the new growth for the sake of diagnosis. It is furthermore a rule in my clinic that pieces shall not be excised from new growths *in vivo* for diagnostic purposes; we must learn to make the diagnosis in other ways. In the case of a very small breast tumor it is occasionally impossible to make the diagnosis before operation. I have sometimes approached the tumor with the knife very cautiously, and could tell before I reached the growth, from the findings in the outlying tissues, whether we had a malignant tumor to deal with or not. I shall have more to say about this at another time, but I feel that one cannot condemn too strongly the universal practice of exploring tumors with the knife or with the harpoon or even with the needle. After investigating the subject superficially, I have the impression that amputations for the truly malignant sarcomata have comparatively seldom been successful when preliminary exploration has been done. If I find it necessary to make an incision into a sarcoma of an extremity, I first apply an Esmarch bandage, and if the tumor is a malignant growth, the bandage is not removed until the growth has been removed. So, too, in cysts of the breast; we should not aspirate them, because (1) they may be malignant and the aspiration harmful, and (2) if malignant, the aspiration does not tell us so. This is the first and I believe the only instance in which an operation for primary carcinoma of the duodenal papilla has been done; moreover, I know of no other case of excision of a portion of the common duct. Heidenhain[9] (Worms) demonstrated last year at the 27th Congress of German Surgeons, a shriveled gall-bladder which he had removed for a small cancer of its wall; after extracting six calculi from the bladder, a little button-like prominence on its wall caught his eye. The microscopical examination showed little or no thickening of the mucous membrane, but unmistakable alveoli in the muscular wall of the gall-bladder; furthermore, some of the lymph vessels were plugged with cancer cells. In three months the patient succumbed to liver-cancer which had attained great dimensions, although at the time of the operation the liver was apparently perfectly normal. At the same session Hollander[10] (Berlin) reported an extirpation of the gall-bladder

[9] Heidenhain: Verhandl. d. deutsch. Ges. f. Chirurgie, 1898, p. 126.
[10] Hollander: *l. c.*, p. 131.

and cystic duct and resection of a portion of the liver for cancer, which *per continuitatem* involved the liver. The result he could not give, for he had performed the operation only three weeks before. There can be little doubt as to the ultimate result of Hollander's operation, although, having operated only three weeks previous to his report, he could not give it.

Case III.—*Dynamic or paralytic dilatation of first portion of duodenum and of the pyloric end of the stomach corresponding accurately to the limits of a sharply circumscribed peritonitis. Gall-stones in gall-bladder and cystic duct. Obstruction of cystic duct and hydrops vesicae.*—Mrs. S. G. M., age 46. Admitted January 31, 1899. Never had typhoid fever. Headaches at intervals all her life, sometimes very severe and lasting several days; especially severe during menstruation. Digestion has been bad for 16 years. After meals a heavy feeling in epigastrium followed by fullness and a feeling of suffocation. Belching of gas common; occasionally would regurgitate a mouthful or two of food. Rarely vomited; never any blood in vomitus. Bowels generally constipated. Micturition frequent, occasionally 20 times a day; generally several times at night. Menses regular. Average weight, 115 pounds. Has lost in weight of late. Present illness, patient states, began December 31, 1898, although she was much run down before that time. This attack came on gradually. Some distention of stomach, and in the afternoon some pain which became severe at night. The pain was in the epigastrium—a colicky pain—which, as she expressed it, "went through the abdomen." Morphia exhibited. Next morning patient felt easier. Morphia continued for next two days. Pain relieved but not entirely subdued. Stools after this were very black, like tar. Physician found something in the stools which he thought might possibly be a gall-stone. Since this attack patient has never been well; constantly in bed. Great deal of soreness through abdomen, and at times attacks of colic. These attacks usually came on in the evening without known cause. Much belching of gas. Bowels regular. Stools not clay-colored. No jaundice. Patient's daughter states that for many years her mother has had attacks of abdominal pain, for which the doctor gave morphia hypodermically. There were intervals of several months between the attacks.

Examination.—On palpation no tenderness except beneath the right costal margin. Here there is to be felt a rounded mass resembling a distended gall-bladder. Right rectus muscle very hard. The mass which is to be felt at the outer edge of this muscle seems lobulated.

January 29th.—Attack of what patient calls "colic." She is nervous and distressed, and complains of abdominal pain. Swallows air and belches it up again.

January 31st.—Transferred to surgical side. On inspection a distended piece of gut between umbilicus and tumor, extending obliquely from the left and above to the right and below, probably six or eight inches in length. Peristalsis is to be observed at intervals; it is not very active, but at times is quite constant. A tumor suggesting gall-bladder projects from the lower border of the liver. It seems to be nodular, or rather has a nodule on it at its upper part. This tumor descends with respiration, and is somewhat tender. The edge of the liver can be felt on each side of the tumor.

February 3d.—Operation: Vertical incision through right rectus muscle. No fluid in abdomen. Gall-bladder distended to size shown in diagram on blackboard. Its walls were thickened and white. The first portion of the duodenum and the pyloric end of the stomach were distinctly distended. Corresponding accurately to the distended portion of the bowel was a slight peritonitis, scarcely more than an injection of the serosa, and an exudate, only enough to cause very fresh adhesions between the duodenum and the gall-bladder. We should hardly call them adhesions; the duodenum seemed rather to be lightly glued to the gall-bladder just as it might be an hour or two after an operation.

I was extremely interested to find that the vascular injection seemed to correspond accurately to the limits of the dilatation (almost ileus at times). The adhesions, if we choose to call them such, were so fresh that they were separated by very slight pressure of the finger. The general abdomen being walled off by gauze packing, the gall-bladder was opened. Its contents were colorless and in consistency like the white of an egg. Cover-slips were negative. First, one large gall-stone was found with a facet at each end. Then a second stone was detected with a probe in the cystic duct, but it could not be dislodged. Cysticotomy was performed and the stone removed in fragments. The previous attempts to dislodge it had evidently broken up the stone. Incision in cystic duct closed by mattress sutures. Gall-bladder treated in the usual way, namely, hermetically sealed about a rubber tube and protected by bismuth gauze, from the general peritonaeal cavity. Abdominal wound closed in the usual way.

At first no bile escaped by the tube, but on the 10th of February bile was abundant in the dressings.

March 2d.—Wound has completely healed. Patient discharged cured.

Various diagnoses had been made in this case: (a) distended gall-bladder with adhesions; (b) cancer of bile-ducts and liver, involving secondarily the colon; (c) carcinoma of the colon, involving secondarily the gall-bladder and gall-ducts. The distended intestine I watched with much interest several times. It seemed to me too small for colon: and no mass could be felt in the distal side of the distended gut to explain the distention. Peritonitis is undoubtedly the most common cause of paralytic ileus, and I have repeatedly observed in appendicitis that dilatation of the caecum and of the ileum may be caused by a very slight, perhaps merely a toxic peritonitis, but I have never before noticed such a sharp line of demarcation between the inflamed and noninflamed portion of the intestine. The dilatation corresponded accurately to the vascular injection. This was the more striking because two portions of intestine so very different were involved. That the comparatively thin wall of the duodenum should be more or less affected by inflammation of its serosa is to be expected, but that such a thick-walled gut as the pylorus and the pyloric end of the stomach should be paralyzed by such a very slight inflammation of the serosa was surprising.

Case IV.—*Conditions suggesting hepaticocholecystostcholecystenterostomy as a possible operation. Common and cystic ducts reduced to fibrous cords, dilated hepatic duct and gall-bladder. Renal colic simulating intestinal colic; relieved by salt infusion.*—Mr. ———, age 60, had been suffering from gall-stones for several years, but not until he became persistently icteric and very ill was the first operation performed. The operator, a distinguished surgeon, found most difficult conditions confronting him. The entire common duct was impervious and reduced to a fibrous cord; the cystic duct, greatly narrowed, was probably impervious; the gall-bladder and hepatic ducts were dilated. The surgeon, very skillfully, I am told, attempted to construct a new common duct over a tube or catheter from the tissue which he had at his disposal. Just what these available tissues were I do not quite understand. For about five weeks, and until this tube was removed and the surgeon went away on his vacation, the patient was fairly comfortable and seemed to be gaining a little. Then he developed high daily fever and occasional chills, and became jaundiced again. I saw the patient in consultation with Dr. Gardner, of Providence, about one week, I believe, after the fever and the symptoms of obstruction had manifested themselves. The gall-bladder could not be felt. There was perhaps a little more muscle resistance on the right side over the region of the bile-ducts than on the left side, also perhaps the suggestion, rather indefinite, of a little induration such as might be caused by fresh adhesions. It occurred to me that in case the gall-bladder and hepatic ducts were still both dilated one might establish a fistulous communication between them, making an hepaticocholecystostomy and then, immediately, a cholecystenterostomy; in all an hepaticocholecystostenterostomy. In any event, we thought that an operation for the relief of the symptoms was imperative. Accordingly a vertical incision through the inner margin of the right rectus muscle was made, avoiding the fistulous tract which remained after the withdrawal of the tube over which the new common duct had been constructed. I worked for two hours trying to identify and to separate the parts concerned in this operation. The gall-bladder, the ducts and the duodenum were glued tightly together and to the under surface of the liver. The gall-bladder which was finally extricated from the tangle was very small, contracted and empty; the cystic duct was a fibrous cord. When bile was at last reached the patient was in such bad condition that the operation had to be discontinued. The parts in the neighborhood of the common and hepatic ducts were so firmly matted together that neither the latter nor the remains of the former had been demonstrated when it was necessary to bring the operation to a close.

The patient rallied satisfactorily from the immediate effects of the operation; but 12 or 14 hours thereafter complained of very severe abdominal pain, which, as he indicated the location of it, seemed to be in the region of the colon and passing from right to left. The pain, though perhaps constant, became excessive during the paroxysms. It was never referred by the patient to his back or sides, nor did it radiate to the testicles or groin or crest or ilium. The abdomen was perfectly flat, and peristalsis could not be observed. Nevertheless, large high enemata of hot water were given, but without appreciable relief. The urine was scanty and very dark and contained albumin and casts and a few blood-cells. Dr. Gardner promptly

attributed the pains to the kidney, and related a somewhat similar case. Believing his interpretation of the pains to be correct and recognizing the fact that something must be done quickly for the relief of the kidneys, I transfused about 750 c. c. under the breasts. The pulse, which was alarmingly rapid before the transfusion, dropped 40 beats within 30 minutes, and 20 beats within five minutes, and the colicky abdominal pains disappeared. Within 24 hours the infusion was repeated with similar results. The kidneys responded promptly to both infusions.

I report this case because (1) it suggested a new operation, hepaticocholecystostcholecystenterostomy, or hepaticocholecystostenterostomy; (2) it was the first of three cases of colic which I have seen associated with scanty high-colored urine; and (3) it was, so far as I know, the first instance of subcutaneous infusion of salt solution for the relief of toxic renal colic. Soon after this Dr. Young, by salt infusions, undoubtedly saved the life of one of my patients whom I had operated upon for appendicitis, and who was suffering from perhaps the most furiously rapid toxaemia that I have ever known of. This case has been reported by Dr. Young in the *Maryland Medical Journal.* The resemblance to intestinal colic is so great that it would undoubtedly be mistaken for it even by experienced practitioners of medicine. This was a valuable lesson for me, for since then I have twice recognized as renal colic this pain, which had been regarded as intestinal colic and treated with high injections. Our list of desperate cases of toxaemia treated advantageously with infusions of salt solution is assuming large proportions.

Case V.—*Choledochotomy performed twice within four and one-half months. The gall-bladder, small and contracted at the first operation, when two stones were in the common duct, was large and distended when only one stone occupied the common duct (the ampulla).*—Mrs. M. P. R., age 58, admitted May 3, 1897. October, 1892, patient began to have moderately severe attacks of pain in the region of the gall-bladder. The attacks would come on suddenly and last several hours unless relieved by anodynes. The pain, milder at first, would gradually increase until it became very severe; it commenced in the epigastrium and extended into the right hypochrondrium. During the winter of 1892-1893 the attacks occurred every two or three days. Occasionally there would be an interval of two or three weeks. During the remainder of 1893 and all of 1894, the attacks persisted at longer or shorter intervals, the pain always beginning in the epigastrium and radiating to the back. Sometimes during a severe attack there would be slight vomiting. Morphia generally gave relief. Patient says that the attacks were not accompanied by tenderness nor tumefaction. In the attacks observed by me there was always tenderness and, after the first operation, distension of the gall-bladder. In the spring of 1895 she went to Hot Springs, Va., where she remained several months. After this she had no pain for 15 months, but did not seem to gain or improve in health. In September, 1896, in Italy, the pain returned. The attacks recurred with great regularity for seven or eight weeks. Most of them were attended by

nausea and some by vomiting. She became jaundiced for the first time in December, 1896, and has remained more or less icteric until admission. Just after the paroxysms the icteric is deeper. For the past five months she had remained in bed most of the time. She vomits frequently, is seldom free from nausea. The bowels have not been markedly constipated; appetite is poor; headaches occasional but not severe. Prior to this illness, however, she suffered very much from headaches. At no time has she had chills or sweating.

Examination.—Patient is quite deeply jaundiced; her color is a dark slate-yellow; tongue heavily coated; body much emaciated; expression rather dull, eyes lusterless. Heart not enlarged; no adventitious sounds. Lungs negative. Urine dark, almost coffee-colored, trace of albumin, much bile-stained sediment. A few bile-stained casts and epithelial cells. Red blood corpuscles, 4,220,000; white, 6,000.

May 4, 1897.—First Operation: Longitudinal incision through right rectus muscle; resection of cartilages of eighth, ninth and tenth ribs, because the common bile-duct was very inaccessible. Choledochotomy; removal of one small mulberry calculus. Exploration of duct fails to detect a second stone. Suture of duct wound. Gall-bladder atrophied and not opened. Bismuth gauze packing to suture in duct. Peritonaeum sutured with fine silk, muscles and fascia with silver wire, and skin with a buried suture of catgut. Little or no shock from the operation.

On opening the abdomen the tissues were bile-stained. There was no fluid in the peritonaeal cavity. The outer surface of the contracted gall-bladder was covered with new connective tissue in which were little masses of fat. The omentum was loosely adherent to the gall-bladder. The cystic and common ducts were easily isolated after division of three of the costal cartilages. No stones could be felt in the bladder or cystic duct. The stone found in the common duct could be moved quite freely up and down in this duct, but could be forced into the cystic duct, the common duct, about 1½ cm. in diameter, being uniformly dilated. Bile flowed from it when opened. It was carefully explored with the fingers but not with an instrument. The gall-bladder was not opened. Two mattress sutures closed the opening in the duct, one preliminary suture being taken before the duct was opened. The sutures were passed without difficulty, the wall of the duct being about 3 mm. in thickness. No leakage occurred after the stitches were tied. The calculus, without facets, was spherical, about 1.6 cm. in diameter, and had a granular surface like a mulberry calculus.

May 15th.—Patient has recovered uneventfully from the operation. She is easily nauseated, however, and has very little desire for food. The stools have about the color of dark coffee and the skin has become lightened perceptibly. She complains, however, of an aching pain in the back, not relieved by posture.

May 24th.—Patient has no inclination to eat; takes almost nothing by mouth. Nutritive enemata, which have been administered uninterruptedly since the operation, are still well borne. About every two days there is quite a definite attack of pain in the umbilical region and back, ushered in by nausea. Vomiting usually follows in a few hours and the distress is relieved.

May 29th.—Condition little changed. Patient is fairly comfortable except for the attacks. Takes a little more food. Stools semi-solid and still quite dark. Urine has trace of bile.

June 13th.—No bile in urine. Vomitus contains considerable hydrochloric acid.

June 26th.—Appetite and digestion have steadily improved. Nausea less constant, often absent. Patient constipated, requires enemata; stools normal as to color.

July 4th.—Much more comfortable. Nausea has disappeared; color greatly improved, but the attacks of pain continue, although they are less frequent.

July 13th.—Slight chill at 5.30 p. m., accompanied by pain in the back and head. Temperature reached 103° at 7.30 p. m.; fell to 99.2° at 5 a. m. Examination of blood for malaria, negative.

July 25th.—Patient has lost one and one-half pounds in weight in the past week. The right lobe of the liver is enlarging. The spleen is palpable. Patient is having short attacks of fever accompanied by slight chills; headache and yawning usually associated with them. The attacks of pain continue; they are still controlled by very small doses of morphia, one-sixtieth to one-fortieth of a grain. She sits up out of bed most of the time.

July 27th.—The pain in the back has of late been accompanied by a slight rise of temperature, 99.2° to 105.5°. The urine contains no bile. The stools consist of light and dark portions sharply separated. Patient is gaining quite rapidly in weight.

August 5th.—Stools clay-colored. Temperature reached 102° last night during an attack of pain. Skin is becoming icteric; urine contains bile; slight pruritus. Patient's weight has increased five pounds in 10 days. From August 8th to 12th no bile in urine.

September 12th.—The attacks of pain and the pyrexia continue. Patient is decidedly icteric after some of the more severe attacks. What we have feared ever since the operation we are now quite certain of, namely, that there is still a stone in the common duct, probably in Vater's diverticulum. The liver is considerably enlarged, but the gall-bladder has not been definitely made out.

September 13th.—Second Operation: Vertical incision near linea alba. Adhesions from previous operation separated without much difficulty. Liver much enlarged; gall-bladder and common duct distended with bile. The wall of the common duct was much thicker; the wall of the gall-bladder, on the other hand, was probably thinner than at the previous operation. A small stone was palpated deep down behind the duodenum, presumably in the ampulla. The line of the old suture in the ductus choledochus could not be very definitely made out, but a short yellowish-white streak, evidently cicatricial tissue, corresponded, I thought, to the site of the original slit in the duct. A fine suture was placed in the common duct to serve as a handle for the subsequent manipulations. The duct was opened, and about 60 c. c. of clear greenish bile escaped. A gauze plug was inserted into the proximal end of the slit to prevent the stone from slipping into the hepatic duct. Interrupted sutures were taken over a hammer of the proper size. The dislodgment of the stone was somewhat difficult. It was a little smaller than the first stone, but otherwise repeated the original exactly. The gall-

bladder was opened, sewed to the peritonaeum, and drained in the usual way; a rubber tube surrounded first by gauze and then by protective being held in place by a purse-string suture of catgut. Wicks of bismuth gauze protected the line of suture in the common duct. The operation was attended with very little shock and the patient reacted very well.

September 20th.—There has been more or less nausea ever since the operation. Patient objects decidedly to stomach washing. Bile is draining actively from the tube. There has been little or no nausea today, but patient is weak and much depressed. The removal of a piece of gauze from the gall-bladder gives patient the first sensation of "heartburn," which she has had since the operation; it lasted several hours.

September 22d.—Patient is thin and emaciated and alarmingly weak; speaking is a great exertion to her. Temperature subnormal. There are no wound complications, nor any signs of peritonaeal irritation or obstruction. Alimentation is almost exclusively rectal; 6 p. m. vomited 1000 c. c. of fluid thick with "coffee grounds." Patient very restless. Examinations of vomitus: No bile; blood corpuscles abundant; altered blood pigment; free hydrochloric acid; no lactic acid.

September 23d.—Patient has vomited several times during the day; in all about 2000 cm. of the same dark coffee ground vomitus. The pulse is very feeble.

September 24th.—8 a. m. Pulse hardly perceptible early this morning; rallied a little after exhibition of salt solution per rectum. Still vomiting large amounts of same fluid, though nothing is being administered by mouth. 12 m. Patient is very low but still conscious. Infusions of salt solution were given under breast and in buttocks. 5.15 p. m. One drachm of 1 per cent solution cocaine given by mouth. 5.30 p. m. Patient vomited 360 c. c. of same dark fluid. Cocaine given again. No vomiting since second dose.

September 25th.—1 a. m. Patient responds a little to the saline infusions. She is moaning and restless. Her nose and extremities are cold. She sleeps in short naps, with her eyes open and eyeballs rolled up. Complains greatly of thirst. Champagne and albumin retained and apparently relished.

September 28th.—Infusion again soon after midnight. Involuntary stools and small amount of dark vomitus. Is somewhat flighty at times. Pulse is thready, irregular, and cannot be accurately counted. She is sighing and seems almost moribund. Too weak to recognize surroundings or members of the family. About noon today I saw the patient for the first time since the third day after the operation, having returned to town as rapidly as possible in response to a telegram sent 48 hours ago. Dr. Cushing, house surgeon, who had attended her constantly, day and night, met me at the door of the hospital with the words, "no hope, she is dying." We went to her room; she was cold and almost unconscious; her eyes were open, the eyeballs rolled up; the lower jaw had dropped. She had had more involuntary movements and could retain no nourishment. Her pulse was little better than a flutter and could not be counted. In less than 45 minutes I returned to the patient and found her pulse 120, and fairly regular in force and rhythm. I doubted my senses when I counted it. She was moreover not so cold, her eyes were not staring, and her lower jaw was raised. A miracle!

From that moment her convalescence was uninterrupted. She slept an hour, and on waking looked better than she had in two or three days. For 24 hours she was so weak that she could barely move her arms. She remembers nothing that transpired on the 23d, 24th and 25th of September.

In eight weeks, on November 22d, this patient left the hospital, not only able to walk but to take a long journey on the railroad. In one period of seven days she gained nine pounds. Her liver was rapidly diminishing in size.

In April, 1898, I had the pleasure of seeing this patient again. Her color was natural, her digestion excellent, her weight above normal and her strength steadily increasing. Her liver did not extend below the costal margin.

I have seen many cases regarded as hopeless recover, but never a being so near death as this have I known to escape it. I have speculated much as to the possible explanation of the very sudden change in her favor, but it would lead us beyond the limits of this paper to discuss the matter. In toxaemias I have noted almost instantaneous drops in the pulse rate. Twice within a month I have observed a fall of 30 beats to the minute follow in less than 30 seconds the opening of an abscess. The abscesses were large and very acute; one was a suppurating laparotomy wound and the other was a circumscribed abscess in the peritonaeal cavity. The very instant that the abscesses were opened the change in the pulse was noted. A few months ago we were preparing to infuse with salt solution a patient upon whom I had operated for gall-stones and whose condition gave me not a little anxiety. His respirations were about 40 per minute and his pulse between 130 and 140. The physical signs indicated not very clearly some consolidation of the lower lobe of the right lung. While the instruments were being sterilized for the infusion, and while Dr. Cushing, the house surgeon, was counting the pulse, it fell to less than 100.

Was the haemorrhage from the stomach in the case of Mrs. R. (Case V) due simply to the prolonged vomiting; or to interference with the circulation of the portal vein (liver cirrhosis, pressure of packing); or to thrombosis of a small arterial branch; or to a retrograde embolism (Recklinghausen,[11] von Eiselsberg[12]) or malposition of the pylorus or duodenum? It could hardly have been due to sepsis for there were no signs of infection. As long ago as 1867, Billroth[13] remarked that in septic cases we might have duodenal ulcers and fatal haemorrhages therefrom. He showed in his experiments upon animals that sepsis might cause intestinal haemorrhage, although, in his experience, it seldom did so in man; if, however, there existed an obstruction to the circulation, such as liver cirrhosis causes, little haemor-

[11] Die Storungen des Blutkreislaufes.

[12] Die Verhandlungen der deutschen Gesellschaft für Chirurgie, 1899.

[13] Ueber Duodenalgeschwüre bei Septicaemia. Wiener med. Wochenschr., 1867.

rhages in the stomach plus the action of the gastric juices might lead to the formation of ulcers. The nausea began almost immediately after the operation. Whatever was the cause of this almost continuous nausea and frequent vomiting was also, probably, at least the remote cause of the haemorrhage. Von Eiselsberg has just reported seven cases of stomach and duodenal haemorrhage following operations upon the abdomen. Haematemesis occurred in six of his cases, and never later than the second, usually on the first day. The haemorrhages were demonstrated in three cases post mortem.

In my case the vomiting of "coffee grounds" was not observed until the tenth day. This patient was so carefully watched that I am quite sure that if haematemesis had occurred earlier it would not have been overlooked. In seeking for a common cause for the stomach and duodenal haemorrhages, Von Eiselsberg excludes vomiting because in two cases there was no vomiting, and in two, haematemesis occurred only a single time; he also excludes sepsis because in four of the cases there was no infection, and reaches the conclusion that "If the behavior of the wound is to be regarded as the cause of the haematemesis, then it must be assumed that in the cases which healed by first intention a retrograde embolism from a noninfected thrombus had taken place."

I wish that there was time to discuss this feature of the case more fully, but I must pass on to the consideration of another fact which this remarkable case developed. There were at the first operation almost certainly two stones in the common duct, one in the ampulla, the other more or less freely movable in the duct, although it fitted it quite snugly; but the gall-bladder was small and contracted and not opened, and the liver was little if at all enlarged; the color of the skin was a light slate-yellow or ash-yellow—not the darker bronze-yellow of complete obstruction. At the second operation, however, when there was only one stone in the common duct, the gall-bladder was distended with bile and quite large, and the liver was greatly enlarged, its right lobe almost reaching the crest of the ilium. The patient's color and symptoms indicated that the stone in the ampulla did not at all times obstruct the duct completely. It sounds almost paradoxical to say that the removal of a stone should increase the obstruction, or that the one stone plugged the duct more completely than the two. I believe that a stone in the diverticulum, particularly a small one, is more likely to block the duct effectually and to lead to distention of the gall-bladder than a stone, however large it may be, elsewhere in the common duct. A stone in the middle of the duct may at first occlude it completely, but the duct wall soon becomes infiltrated and thickened, it loses its elasticity, and, when distended with bile, stretches. The stone no longer plugs the duct tightly and bile trickles by into the intestine even when a second stone occupies

the diverticulum, but when the proximal stone is removed, the bile instead of trickling up to the distal stone is probably jetted against it with sufficient force to hold it as a ball-valve. Furthermore, dilatation should not occur so readily in the portion of the common duct protected by the duodenal wall as in the free portion. In 1885 I operated upon a patient whose common duct contained a stone larger than the largest pecan-nut; at times one-half of this stone projected into the duodenum, the other half occupied the duct; a flange had been cut on the calculus by the cicatricial ring, which engaged it and prevented it from slipping into the intestine; and yet this patient was so very slightly jaundiced that a stone in the common duct had not been suspected.

Case VI.—Miss M. H., age 30. Transferred to surgical from medical side, January 27, 1896. Indigestion for eight years. For past four years the "gastric distress" has been very great. Patient describes a "gnawing sensation" in the epigastrium. Colicky pains radiated throughout thorax, but were at times very severe "in the back." Two years ago she had typhoid fever. For the past six months she has had frequent definite sharp gall-stone attacks with nausea, and four times with vomiting. Never blood in the vomitus. No chills, fever nor jaundice. Patient is a confirmed invalid. She suffers from headache and occasionally from vertigo.

Examination.—Abdomen flat. On deep inspiration spheroidal tumor is to be seen just below the costal margin on the right side. This tumor can also be felt. It moves with the enlarged liver, ascending and descending with the respirations. Last September patient first began to have attacks of pain in right hypogastrium, and accompanied by nausea and sometimes by vomiting. Spleen not palpable. The severe pain suffered by patient could be relieved by drawing up the knees. This pain radiated to the right shoulder-blade.

January 28, 1896.—Operation: Cholecystostomy. Vertical incision through the right rectus muscle. Elongated right lobe of liver. Very dense fibrous adhesions between the gall-bladder and duodenum. These adhesions were divided with great difficulty, and finally what appeared to be gall-bladder presented. It was aspirated, and a thick greenish fluid withdrawn. It was consequently opened with some confidence, but proved to be duodenum. It was sutured again at once, the suturing being very difficult because the muscular coat had been separated from the submucous coat during the dissection of the adhesions. The muscular coat, owing to the chronic inflammation which had existed for so many years, had become sufficiently fibrous to resemble cicatricial tissue, and consequently was unintentionally stripped from the submucosa. When the submucosa presented, it did so in the form of a little knob-like bladder, this coat resembling almost precisely the wall of the gall-bladder. The gall-bladder was finally found, deeply imbedded in adhesions, almost 4 cm. to the right of its usual position and far under the enlarged liver. It was opened, and one large oval stone, 2 cm. by 1 cm., removed. In the course of the operation a small abscess was discovered in the midst of the adhesions. Patient's recovery was con-

siderably retarded by digestive disturbances, which finally disappeared completely.

April, 1899.—Patient says that she is in robust health and wishes to become a masseuse.

CASE VII.—The history of this case cannot be published at present.

CASE VIII.—*Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later adhesions so extensive and so dense that the common duct was reached by a retroperitonaeal route, over the right kidney.*—Mrs. M., age 35. Admitted March, 1895. No typhoid fever. First attack of gall-stones, six years ago, began with sharp attack of pain in the right side of the abdomen. Two years ago miscarriage at seventh month; was ill in bed thereafter four months. While in bed patient had great pain in region of gall-bladder, with high fever, for 10 weeks; was continually blistered over liver. Eight weeks after the abortion she felt suddenly something "give way"; this giving way was followed by great relief, and by horribly offensive discharge of pus and blood from the rectum and mouth. These discharges were irritating, gave her a very sore throat and mouth. She spat blood and matter for two or three weeks, and the stools during this time were very offensive. She has had pain and tenderness constantly, with occasionally severe attacks since that time; has been jaundiced more or less ever since, but more markedly so since last July. On admission, body jaundiced and greatly emaciated; tenderness over the entire abdomen, especially in the region of the gall-bladder. Liver, in deep inspirations, extends two fingers' breadth below costal margin, and has a fairly sharp edge. Spleen palpable; stools acholic.

March 19, 1895.—Operation: Liver small, barely reaches costal margin; its high position complicated the operation. Colon adherent to liver by rather loose bands; gall-bladder exposed when these were divided. It was high up under the liver and no longer than the tip of the little finger; it was not opened. Adhesions were so dense over the common duct that the peritonaeum was opened over the right kidney, and the common duct approached from behind under the peritonaeum. A stone being felt, the common duct was the more readily exposed; the stone was extracted through a hole made by ulceration. This hole proved to be at the junction of the duct and the duodenum, and was shut off from the peritonaeal cavity by very delicate adhesions. The intestinal part of the opening was closed completely, the duct part as well as possible. The sutures were passed with great difficulty. The opening in the duct could not be completely closed, the tissues being necrotic, and bile escaped through it even after the sutures were drawn tight. Probing of the duct was carefully done. No other stones were found.

October, 1895.—Six months after operation, patient is very well. She weighs 100 pounds.

April, 1899.—Examined in my private office; patient still enjoys perfect health; she now weighs 190 pounds. Patient states that she has recently given birth to a healthy child.

I report the case of this woman because (1) she was so very ill when operated upon; (2) it is one of the two cases in which intestinal perforation had undoubtedly occurred prior to operation; (3) the common duct was approached in a new way, namely, from behind the peritonaeum; (4) the stone,in the ampulla, had ulcerated through the walls of the ductus choledochus and the duodenum, and would perhaps soon have been extruded; (5) the increase in the weight of the patient seemed phenomenal; it was almost doubled within the year following the operation.

What the result to the patient would have been if this stone had ulcerated its way out of the common duct is quite certain, and yet I have several times found stones imbedded in adhesions outside of the bile passages; they were usually close to the gall-bladder. Once I discovered a stone in the wall of a thick-walled gall-bladder; it was completely buried and was causing no disturbance, and was detected in the process of sewing in the drainage tube. This is, I believe, the only case in which I have not divided all of the adhesions encountered. If no contraindication exists, such as necessity for abbreviating the operation, we should separate the adhesions if possible. The chance of meeting fistulous openings between bile passages and the intestine I regard as an indication for thorough exploration rather than a contraindication to it. Not infrequently adhesions alone are responsible for the symptoms which persist after the calculi have been removed by the surgeon or have escaped in other ways.

DISCUSSION.[14]

Dr. Homans.—My cases at the hospital for the last three or four months have been principally gall-stone cases of extrauterine pregnancy; there have been a great many of them. In some of the cases in which I expected to find gall-stones I found none, but thickening of the gall-bladder and adhesions in that neighborhood. I should be at a loss to explain how Dr. Halsted's patient with the contracted gall-bladder dilated again. I supposed it would be impossible for these contracted gall-bladders to dilate.

I am very much interested in the general question of the pneumonia that follows these operations whether of gall-bladder or appendix. I have one now in a little girl. The pulse has been 152 for forty-eight hours, and I imagine it is a case of benign embolus coming from my operation for appendix in the interval two days ago. There are no abdominal symptoms, but the pulse is 150 and respirations nearly 50.

I am certainly in accord with Dr. Halsted as to the value of transfusion in these septic cases. It seems to me I have seen it of great value. I am afraid when I have given my subcutaneous injections I have not been careful not to have a tumor form. I am afraid that I tried to get in a good deal at once. If there was not a tumor I should feel I was going too slowly.

[14] From the Boston Medical and Surgical Journal, Dec. 28, 1899.

I have also supposed that infusion in veins was of more value than indirect transfusion in the cellular tissues.

Dr. Cabot.—I have nothing to add to Dr. Halsted's very complete explanation of his methods in gall-bladder surgery. I was very much interested in the part of the subject which I wish he had talked about a little more, namely, that of the technique, the method of keeping the parts exposed sufficiently to make his manipulations easy. I was also interested in the incision that he uses, because it is a different one from the one I have always employed. I have used the diagonal incision from the edge of the rectus, or a little beyond it into the right flank, and I can see that with his incision he might be able to get the intestines further towards the left, and perhaps in that way uncover parts which I have found rather difficult of access. Certainly it is a suggestion I am very grateful for and shall try at the first opportunity. Also, I was extremely interested in his explanation of his hammer, which of course I had read about but had not seen used, and I can readily believe it would be of a great deal of service in guiding the sutures.

There is one explanation of that dilatation of the gall-bladder which seems possible. He spoke of the first gall-stone he removed as lying rather loosely in the dilated portion of the duct. It occurred to me to wonder whether there might not have been a smaller stone back of that, a stone possibly in the hepatic duct. I remember one case where, after clearing a stone out of the common duct, I felt such a stone in the hepatic duct, and spent a long time trying to get it, and finally broke it and removed a small portion, but a considerable part escaped back into the hepatic duct where I could no longer feel it. I was obliged to leave it, but fortunately it caused no further trouble. May not a small stone have been behind the larger one, and when the larger one was removed, come down and become wedged in the lower portion of the common duct in front of the dilatation which he describes, and have filled that duct so full that the gall-bladder was obliged to distend?

Dr. Richardson.—I am sure that we all have been very much interested and feel grateful to Dr. Halsted for his paper. It seems to me that the variety of conditions of the biliary passages is so great that one might have a very considerable experience and yet not meet with any of the rare cases he has spoken of; and, on the other hand, one may see a few cases only and strike just those curious things. The cases given are in point. Now, in all the gall-bladder cases I have seen, those in which the stone is in the common duct are very few in number, so that my experience has been almost entirely with stones in the gall-bladder without jaundice. That part of the subject is comparatively simple. The surgery of the common duct, stones in the common duct and in the bile-duct too, seems an entirely different matter from stones in the gall-bladder. The difficulties of course are very great, and the particular points one wishes to hear discussed are those raised by Dr. Halsted. First, with reference to the diagnosis of these cases. I heartily agree with him that it is very desirable beforehand to make the diagnosis, and, as he says, if we find out beyond doubt by exploration, we may neglect some of the important points. It certainly is extremely desirable to avoid a useless exploration. My experience is that exploration in cancers of the

abdomen, especially in cancers about the gall-bladder, common duct or pancreas, has a large mortality. That is not my experience alone either. I looked over the records of our abdominal ward the other day, and was impressed by the large number of deaths in gall-bladder surgery in the hands of all the surgeons in explorations in which there was cancer. They die two or three weeks after the operation, not the result of it, but hastened by it. So it seems to me very desirable to eliminate if we can by a correct diagnosis the hopeless cases and not subject the patient to the operation.

The next point, the incision, interested me, and I am glad to know that that rectus incision is made. That was the incision that Tait used first, and we all used the oblique incision. I have now come to the rectus incision, but go rather through the outer portion of the muscular fibres of the rectus, and that gives a beautiful view of the common duct and also of the colon, and, if necessary, you can go toward the stomach and it does not cut across muscular fibres.

One thing I have had a little experience in, and that is in the matter of haemorrhage—Dr. Halsted asked for that—but not haemorrhage from the stomach. I formerly believed that there was not much danger in operating on jaundiced cases—I mean danger of haemorrhage—till some years ago a patient died from the prolonged ooze from the gall-bladder; nothing would stop it. This year I lost a patient within 12 hours after removal of gall-stones in a very jaundiced woman in which in the whole operation there was not a single ligature applied: it was not necessary. That woman died, and apparently every capillary in the field bled. Not only that, but the peritonaeum all around the wound bled. I think one of my colleagues had a similar experience, an extensive capillary ooze, which proved fatal in spite of efforts to prevent it.

Another point is the localized paralyses of the intestine. These usually are the result of gall-stones, but I have found acute inflammations in two or three instances, I think four in all, in which there were no gall-stones, and yet there was an acute infection of the gall-bladder, and the symptoms in most of the cases were those of acute intestinal obstruction. I think all that had these symptoms recovered, but the obstruction was apparently due, as pointed out by an English author, to the fact that the hepatic flexure of the colon was distended and covered with exudation, and apparently the seat of a localized infection. It is very extraordinary, it seems to me, that an acute inflammation of the gall-bladder should have the symptoms of an acute intestinal obstruction, and I think that is the explanation of it.

With reference to the time of operating, it seems to me so desirable to take out gall-stones when they are in the gall-bladder, that if a patient has had several attacks of jaundice and got over the jaundice, it is wise to wait awhile to see if he will not get over the present attack; then, the common duct being clear, it is probably true that the stones are in the gall-bladder. I have followed that whenever I could, but there are cases in which it is clear from the duration of the jaundice that there is little if any chance that the stone can be made to pass. Then, of course, if the gall-bladder is opened and the common duct is not completely cleared we have the conditions for permanent fistula. Dr. Mixter has had a very gratifying case of that kind in which secondary operation proved efficacious.

One other point occurs to me and that is whether to sew the gall-bladder to the abdominal wound or not. I have always performed that operation when I could. Eight or ten years ago a case came to me in which the gall-bladder was a little knob on the under surface of the liver three or four inches from the skin. There never had been any question that you ought to sew the gall-bladder to the abdominal wound to prevent extravasation of bile. I did not know what to do in this case. I was then led to the last resource of a man who does not know what to do, and that was to put in gauze. We took the gall-stones out of the common duct and then put gauze about, as Dr. Halsted mentions.

I am glad to hear that it is regarded in Germany, by the most experienced, wise to prevent extravasation by the use of sutures in the tubes, for I have felt perhaps that we were a little too confident in the use of drainage and in the closure of gall-bladders by suture. I never have dared to close a gall-bladder by suture and drop it into the abdominal cavity and sew up the abdomen. I dare say it is safe enough at times, but if things do give way it takes but a very short time for the abdominal cavity to be flooded. When I have sewed the gall-bladder up I have made provision for extravasation by a small strand of gauze and that has not worked badly. I have not had the good fortune not to lose cases of gall-bladder surgery. I think Dr. Elliot looked up all the cases here and found the mortality about 20 per cent. If we leave out the cases of malignant disease the mortality is very much smaller; still it seems to me there is present the danger of haemorrhage in jaundice and occasionally the danger of peritonitis, but that right upper quadrant is so protected by the mesentery and the colon that the infections are easily limited to that quadrant. I have never had a case of peritonitis following gall-bladder surgery. Those cases that have died have generally had a base of malignant disease, and have died in two or three weeks after the operation.

Dr. Mixter.—There are two or three points Dr. Halsted has mentioned, and one or two he has not mentioned, which I think are of great interest. First, the question of sewing the gall-bladder to the abdominal wall. If there is one thing I think is an unsurgical procedure it is the sewing of any hollow viscus to the abdominal wall. I do not believe the man lives who can make a tight joint and do it in any reasonable time, especially when he has to sew it on an incision very much longer than the incision of the hollow organ. That is just as true of the intestine in artificial anus as in the gall-bladder. In addition to the strain brought on the gall-bladder we must remember the abnormal position in which it is placed by such suturing. I believe most thoroughly in the method Dr. Halsted has suggested, only I think it is better to tie it with a good piece of silk and tie tight enough, so that when, in two or three days after, the packing can be removed the whole thing comes out because where the string has gone round there has been a slough. I have never seen any infection follow such slough. The same method is applicable to the intestine.

Then there is one point Dr. Halsted did not allude to, except perhaps incidentally, and that is the question of leaving these wounds in the common duct unsutured. I have had quite a number of cases of stones in the common duct, and a part of them I have sewed up and a part I have not. I

believe it is said that the statistics are better in those cases where suture has been used. I have certainly seen cases where it was impossible to suture, not having tried Dr. Halsted's mallet, but where a considerable opening had to be made. In one case two openings at different points had to be made, and the patient's condition was such that it was absolutely essential to stop the operation. In those cases I have simply put a tube down to the duct and packed some gauze round it, and the patient got well. I have had at least four patients recover where there has not been suture of the duct. As far as my experience goes, one has been as successful as the other, and the biliary discharge from the duct, which has lasted a few days, has stopped in every case.

There is another class of cases, which has not been mentioned, which has interested me—two classes in fact, one in which you operate expecting to find a stone in the gall-bladder or common duct where the symptoms have been almost typical. There have been two of these cases referred to me from the medical side at the Massachusetts General Hospital, and in three cases now I have opened the abdomen expecting to find a gall-stone or some obstruction and have found a very localized tubercular peritonitis, no involvement that I could find about the duct, no enlarged glands, such as Fenger describes, but a little localized peritonitis. I enlarged the incision to see if the tuberculosis had extended, and it was, apparently, only at that one point. Those cases got well and, so far as I have been able to follow them, they stay well. The other cases are those cases which seem to resemble gall-stones, but where you have a localized inflammation about the entrance of the common duct and the pancreatic duct in the head of the pancreas. There I think Dr. Whitney will remember one or two autopsies being made at the hospital where the patients have died following operation for supposed gall-stone, where the only possible thing found has been very localized pancreatitis, nothing like the haemorrhagic form, but apparently a chronic subacute form of pancreatitis characterized by minute abscesses in that neighborhood. Those conditions can be recognized at the time of the operation by the swelling. In both cases I thought the trouble was malignant and in both it was found to be simply this inflammatory process.

These gall-bladder and gall-duct cases I think are almost the most interesting we have. They may be the most puzzling. I remember Fenger saying to me that he knew nothing which would make one feel so helpless as to open the abdomen expecting to find some definite thing in connection with the gall-bladder or common duct, and find you could make out absolutely nothing.

Dr. Halsted.—I cautioned against giving the infusion of salt solution too rapidly, for the tissues may be so damaged by it that annoying and even serious consequences may result.[15]

[15] Since giving this warning, two cases in which gangrene followed the too rapid or too forcible injection of salt solution have come to my notice. In both instances considerable force was exercised, and the injection was in neither case discontinued until after a large, perfectly white central area, surrounded by a livid zone, had been produced.

The infusion should be discontinued before an unnatural resistance is encountered, and before the skin becomes tense, or signs appear that the circulation of the tissues is being interfered with. A graduated fountain syringe is perhaps the best instrument for the purpose, an elevation of about four feet above the patient being sufficient. A half hour or more may be taken for the injection, the patient sometimes falling asleep while it is being made. We have twice divided one or more ribs: once because the liver was very small, and once because it was very large. I am indebted to Dr. F. Lange of New York for this suggestion. In extirpation of a tuberculous kidney which was very adherent to the diaphragm and to the colon, I once found excision of the 11th and 12th ribs a most helpful procedure. I employ a vertical incision in the rectus muscle. Twice I have used the linea alba. One can reach the common duct perfectly well with the incision through the linea alba, but could not pack off the gall-bladder so well from this incision. Incising over the inner edge of the right rectus muscle, one might dislocate this muscle outwards during the operation, and for the packing, split the muscle a very short distance just over the gall-bladder.[16]

In work upon the common duct, the liver should not be retracted upwards too forcibly, for the duct goes with it and is not so easily reached as when the intestines are drawn well down, and to the left, and the liver gently elevated or rotated on its transverse axis. The long vertical incision permits this displacement of the intestines particularly well. Kehr states that some of his operations upon the bile-passages were so prolonged and so arduous that stimulants seemed to be indicated for himself and assistants. I have the impression that these operations, although sometimes very difficult indeed, are less fatiguing than formerly. I should be glad to believe that the stone found in the ampulla at a second operation upon the ductus choledochus was in the hepatic duct when the first operation was performed. In 1881 I removed seven stones from the gall-bladder (empyema). A large stone in the common and hepatic ducts caused the death of this patient two years later. At the autopsy a stone as large as the largest pecan nut was found in the middle of the atrophied liver in one of the radicals of the hepatic duct. This duct with the choledochus formed a straight tube almost as large as the ileum. I believed from the history of the case that this stone had for many years been traveling up and down in this tube; it had almost worked its way into the duodenum, into which it could project for half its length and would have slipped if a flange-like enlargement had not prevented.

[16] Recently operating upon an unusually corpulent woman (weight, 250 lbs.), for a stone in the common duct, I split the rectus muscle for a short distance in its upper part, and gradually working my way to the middle line, continued the incision in the linea alba almost to the pubes. One may take advantage of the transverse fibrous intersections of the muscle (lineae transversae), to reach the middle line; and in this way, perhaps, paralyze fewer fibres of the muscle. The finer nerve anastomoses, the importance of which, surgically, we have not determined, would, even by this method, not be altogether spared. The innermost and some of the deeper fibres of the rectus muscle are not intersected by the linea transversa. The ingenious and beautiful method of Lennander is applicable to some cases, but not to those in which a very long incision is required.

Yes, I think that the proportion of interesting cases has been very large. This is perhaps, in part, due to the fact that until within a year or two only the comparatively serious cases would submit to operation. None of the little contracted knob-like or button-like gall-bladders which we have left undisturbed at the operation, have given us trouble subsequently. More to be feared are the larger bladders whose cystic ducts, occluded by stones, may become impervious from stricture after the stones have been removed. Excision of the gall-bladder should not be so dangerous if properly performed. One must not cut too close to the liver.[17]

We draw our purse-string suture of catgut so tight about the tube in the gall-bladder that leakage does not occur earlier than about the seventh, sometimes the tenth day. All the bile is drained by the rubber tube; this tube is wrapped first with a little gauze, and then with gutta-percha tissue; the latter prevents granulations from growing into the gauze, the former gives the suture, perhaps, a better grasp on the tube. We practised this method in some of our first cases, and find ourselves employing it almost to the exclusion of other methods.

Undoubtedly other surgeons, working independently, have devised the same or similar methods.

I have not met with tuberculosis of the bile-passages.

Some surgeons stitch the incision which they make into the common duct; others do not. Among the latter are men of large experience in the surgery of the bile-passages. If the patient's condition is good and the gall-bladder has not been removed, I suture the duct. When the duct has been carefully sewed it is not necessary to pack the peritonaeal cavity so generously as one packs it when the duct is not sewed, and the bile, instead of soaking the dressings and the patient, is syphoned with a rubber tube from the gall-bladder to a bottle in or under the bed. Packing promptly soaked with bile might not wall off the general peritonaeal cavity so well as dry gauze. The Mikulicz pad and gauze handkerchiefs caught up by the middle (conical pads) should not be used, because their extraction is sometimes very difficult and perhaps dangerous, and certainly often gives the patient unnecessary pain. We fancy narrow strips of bismuth gauze for the packing. These strips are about two inches wide and four layers thick, with the raw edges most carefully folded in. The duct should be sutured as rapidly as is consistent with perfect work. It is not by any means always necessary to use the hammers, but sometimes they seem almost indispensable. The exquisitely fine needles with a full curve and a spring eye, made by Wülfing-Luer, of Paris, and the needle-holder designed by Cushing for these needles, have become indispensable tools for this and other work. The needle-holder has a convex and a concave blade which accurately fit the needle, and hence do not break it. The gauze should be removed with gloved fingers and not with forceps, because as each strip is tested for withdrawal it should be unfolded, spread out to its full extent and gently pulled, first at the edges.

[17] Probably the suggestion of Dr. Mayo will prove to be a very valuable one in some cases. He advises pulling out the inner lining of the gall-bladder (its mucous membrane), leaving its outer coats. Annals of Surgery, Oct., 1899.

RETROJECTION OF BILE INTO THE PANCREAS, A CAUSE OF ACUTE HAEMORRHAGIC PANCREATITIS[1]

Mr. T., aged 48, a corpulent and robust looking man, had been subject to attacks of "indigestion," attended with pain in the epigastrium and a feeling of distention, for several years. These attacks would sometimes incapacitate him for business. He had a severe attack of this kind last Christmastide. He described also attacks of "vertigo," which had laid him up for 8 or 10 days every spring, with perhaps one exception, for the past 10 years. At the end of April, 1901, he arrived in Baltimore after a hard railroad trip of about eight days. On the way, suffering with indigestion, he bought a two-ounce package of bicarbonate of soda, half of which he consumed. After luncheon on the day of his arrival he was seized quite suddenly with a severe pain in the abdomen; he was nauseated and expressed his desire to be relieved of the "gas in the stomach." His physician administered calomel, and later nux vomica and carminatives. For 24 hours he was relieved; then, after eating buckwheat cakes, the pain returned. Occasionally drinking large quantities of water, he forced himself with difficulty to vomit. He suffered almost constantly more or less pain for a week, but took his meals regularly and slept about as well as usual. About noon on the 5th of May, after luncheon, the pain became very severe; morphia administered hypodermically three times during the afternoon, ½ grain in all, did not give much relief. Inhalations of chloroform had to be given. At 9 p. m. I was asked to see him by his attending physicians. As I entered his bedroom, he was walking about in his pajamas, excited and nervous, and his teeth were chattering; he seemed to be in great pain. His pulse was full and regular, 92 the first count and 87 the second. When I attempted to examine him he made an effort to keep quiet but in a moment had to spring up again. He was sensitive to pressure over the epigastrium, but not exquisitely, the point of greatest tenderness being a little above and, I thought, to the right of the umbilicus. He was somewhat cyanosed. My attention was called to the cyanosis by the print of my fingers on his abdominal wall. His condition was so good that I thought, with his physi-

[1] Presented before the Clinical Society of Maryland, Baltimore, March 15, 1901. This article is followed immediately in the same number of The Johns Hopkins Hospital Bulletin by Dr. Eugene L. Opie's important paper on "The Etiology of Acute Haemorrhagic Pancreatitis.—EDITOR.

Johns Hopkins Hosp. Bull., Balt., 1901, xii, 179-182. (Reprinted.)

cians, he was probably suffering from gall-stones. He refused to go to the hospital. Hot baths during the night relieved him, I am told, for the time, but he had to be chloroformed frequently. In the morning he was anxious to go to the hospital and was operated upon immediately after his arrival, about 11 a. m.

Operation.—The cyanosis of the patient was much more striking as he was laid on the operating table, and he vomited as he was being anaesthetized. The abdomen was not distended, but the panniculus was very deep. On opening the belly through the middle line blood-stained fluid escaped and at once it was noticed that the omentum showed abundant fat necroses; these necroses were to be seen in the subperitonaeal fat, in the mesentery, along the lesser and greater curvatures of the stomach, etc. In order to explore more fully the pancreas and to make sure that a certain haemorrhage in the wall of the stomach, near the pyloric end, had not produced any serious lesion, the omental bursa was rapidly opened. Nothing that could be designated as a tumor mass was made out; the entire region of the pancreas could be palpated. The tissues over the pancreas were slightly infiltrated with blood-stained serum. The common bile-duct, however, was distended to the size, perhaps, of an index finger. The presence of a stone in the diverticulum was of course suspected, and a careful though hurried search made, but none could be felt; the fluid in the abdominal cavity was rapidly sponged out and a gauze pack placed over the head of the pancreas. The abdomen was then closed. The patient died within 23 hours.

Pain, vomiting, distention of the abdomen, sometimes an elastic swelling in the region of the pancreas, fluid in the peritonaeal cavity, pulse 140 to 160 or higher, cyanosis, collapse—these are the symptoms which the surgeon calls to mind when he pictures to himself a case of acute haemorrhagic pancreatitis, and hence it is that this disease has so many times been considered acute intestinal obstruction. My patient was strong, restless and walking about the room, his pulse was 92 the first count, 87 the second; the abdomen was not only not distended but, according to the patient, had greatly diminished in size during the few weeks preceding this illness; the reduction in the size of his waist, as evidenced by the considerable space between the band of his trousers and his abdominal wall, was a matter which apparently gave him some concern, for he referred to it more than once. Vomiting, if present, was so inconspicuous a symptom that it had not been noticed; the patient had perhaps three or four times tickled his pharynx because he thought it relieved him to gag and bring up a little mucus from his stomach. When I saw him about 13 hours before the operation and again an hour before it, pain in the epigastrium and slight cyanosis were his only symptoms. But the pain must have been intense and seemed greater

than I had ever seen it in cases of gall-stone. I had the misgiving that I was in the presence of an unfamiliar affection and was prepared for a surprise when I opened the abdomen; and yet acute pancreatitis did not occur to me, my conception of the clinical picture was so different. But I shall not soon forget this case; the excruciating pain in the epigastrium and the cyanosis; altogether, a clinical picture different from anything that I could recall. To save my colleagues and students the humiliation of making the same mistake, I have thought that it might be well to represent graphically the sign which this obscure case presented, the white print of fingertips in a slightly cyanosed field just over the site of greatest pain. Attacks of acute haemorrhagic pancreatitis, mild and severe, are probably much more common than is generally supposed, and I believe that the clinical picture when comprehended is sufficiently definite to be easily recognized by the general practitioner. What other affection is accompanied by such severe pain; pain so excruciating that anaesthetics alone relieve it?

The autopsy was most carefully made by Dr. Opie, whose description of it will follow. The stone, which I could not find in my hurried search at the operation, was almost too minute to have been detected under the circumstances, and even at the autopsy it was only after prolonged handling and probing of the papilla itself outside of the body that the presence of a stone was determined. Opie has found that gall-stones have been present in the majority of the more recently reported cases of acute haemorrhagic pancreatitis. In some instances they were, undoubtedly, not carefully searched for, in a few they may have been overlooked and in others they may have passed the papilla, having been arrested in the diverticulum long enough to produce the lesion in the pancreas. If it is true, as this case and Opie's experiments recorded below prove almost beyond question, that acute haemorrhagic pancreatitis may be caused by bile retrojected into the pancreatic duct, the inference that milder lesions and subacute and chronic changes may be produced in the pancreas by the mere presence of bile in its ducts is natural. The fact that the entire pancreas is not always or even usually involved, normal areas being found here and there among the haemorrhagic ones, makes it seem not unlikely that quite small patches may at times be affected and that the symptoms after very limited involvement might be overlooked or misinterpreted. Epigastric pain, rapid pulse, nausea, vomiting and possibly haematemesis coming on either soon or long after operations upon the common duct might in some instances be attributable to lesions in the pancreas.

The Mechanism.—The arrangement of the parts concerned in the production of acute haemorrhagic pancreatitis reminds me of the hydraulic ram in its primitive form. The ductus choledochus is the feed pipe, the pan-

creatic duct the delivery pipe and the calculus the ball-valve or stop-cock. Although I know of no experiment to determine the force with which bile may be ejected from the gall-bladder, it is conceivable that the sudden and complete interruption of the flow of bile during digestion by a calculus might give rise to a retrojection spurt of considerable volume and velocity. But whether this force is considerable or not, since the pancreatic juice and the bile are secreted at almost the same, quite low (about 200 mm. of water) pressure, it would probably be sufficient, as Dr. Opie will show, to drive the bile into the pancreatic duct under the proper conditions.

Why is pancreatitis haemorrhagica acuta such a rare disease?

1. That bile may be retrojected into the pancreatic duct, the stone must be (*a*) too small to occlude the pancreatic duct or interfere with the force of the jet and at the same time (*b*) too large to pass the papilla.

2. A narrow papillary orifice, such as we found in my case (a rare condition), would predispose to this affection, because many stones small enough to fulfill (*a*) the first condition are too small to fulfill (*b*) the second.

3. One calculus would be more likely to cause the pancreatitis than several, for other stones in this duct, unless very small, would weaken the force of the bile-spurt which drives the ball-valve against the papillary orifice. I have elsewhere called attention to this fact.[2]

4. The gall-bladder must perhaps be normal or nearly so; not thickened, shrunken or weakened by inflammation. Accordingly, one must have a calculus or calculi which have produced insignificant changes, if any, in the walls of the bladder.

5. The anomalies which Dr. Opie will consider protect a certain proportion of cases.

6. A predisposition may be necessary, as is given by adiposis and excessive use of alcohol.

Apropos of what I have said as to the possibility of mild attacks of haemorrhagic pancreatitis after gall-stone operations, Dr. Finney has just told me the story of a most interesting and perhaps not wholly unique case. Four months ago he did a choledochotomy for two large soft stones in the common duct. The duct was enormously dilated, the gall-bladder atrophied. The stones were almost as mushy as damp salt, and crumbled to pieces in the duct. The detritus was removed with extreme care and the duct afterwards repeatedly flushed with the physiological solution; notwithstanding this it seemed to Dr. Finney that some grains still remained in the duct. The incision into the common duct was sutured and the convalescence was entirely uneventful except for a trivial leakage of bile beginning about the

[2] Halsted: Contributions to the Surgery of the Bile Passages. The Johns Hopkins Hospital Bulletin. January, 1900.

seventh day p. o. A few days ago, when in robust health, the patient was seized with excruciating pains in the epigastrium, unlike any that he had ever experienced. Dr. Finney was telegraphed for promptly, and reaching the patient in a few hours found him vomiting, collapsed, cyanosed and suffering pain so severe that morphia in large doses did not control it; the pulse was about 160, pressure over the pancreas was unendurable, the abdomen was distended. Acute pancreatitis was suspected, and operation, considering the collapsed condition of the patient, deemed inadvisable. The following day the patient was brought to The Johns Hopkins Hospital, his condition was greatly improved and 48 hours later he seemed perfectly well.

Is it not probable that in this case one of the fragments increased in size may have been responsible for the attack? Was the fragment passed? What were the lesions in this attack? Acute pancreatitis just beginning to be understood will probably soon become a household word.

Treatment.—We must learn to make the diagnosis promptly, and to distinguish gall-stone attacks *per se* from those attended with pancreatic complications.

To search for and remove the stone in the diverticulum as soon as possible after the appearance of the first symptoms would be the correct procedure in some cases if the true nature of the attack could be recognized early enough. If this patient of mine had been operated upon and the stone removed at some time prior to the onset of his severe symptoms, perhaps at any time within the first seven or eight days of his illness, it seems probable that his life could have been saved. Without operation there was little if any hope for him, for the conditions responsible for the lesions would have persisted. It was evident at the operation that the common duct was obstructed, but the patient's condition absolutely contraindicated prolonged search for the cause, which probably could only have been determined by opening the common duct or the duodenum, so minute was the calculus. Operation should not be undertaken upon cases in collapse, but the bloody fluid, probably highly toxic,[3] may be hastily evacuated by laparotomy (local anaesthesia) in cases too ill for radical operation.

Of 25 cases of acute haemorrhagic pancreatitis operated upon only two have recovered, a case operated upon by me 11 years ago[4] and Hahn's case recently reported.[5]

In his recent article Professor Hahn expresses a desire to learn if the operation performed by me in the case which recovered was prolonged by

[3] Hahn: Deutsche Zeitschr. f. Chir., Bd. 85, Heft 1.
[4] Körte: Die chirurgischen Krankheiten und die Verletzungen des Pankreas.
[5] Hahn: *l. c.*

the usual search for some cause of intestinal obstruction, and the hope that, in future, inoculations of culture media will be made from the blood-stained abdominal fluid. It gives me pleasure to be able to reply and to state that fat necrosis was at once observed, the diagnosis promptly made and the operation, therefore, probably a short one: drainage was not employed. This patient is alive and apparently well. In the second case, inoculations from the bloody abdominal fluid were made, and with negative results.

It seems not improbable that, as Hahn states, the rapid evacuation of the bloody fluid in the abdominal cavity may in some cases be beneficial. Hahn believes that this fluid is highly toxic and perhaps infectious, and emphasizes the fact, exemplified by one of the cases which he reports, that large retroperitonaeal extravasations of blood cause incomparably less disturbance than we see in these cases of haemorrhagic pancreatitis in which the loss of blood is insignificant. I had read Hahn's article only a few days prior to the operation upon this case and was acting upon his suggestion, but coming so quickly upon the dilated common duct I felt myself compelled to make a hurried search for the cause of the obstruction. I have little doubt that my operation hastened the death of the patient.

If a stone in Vater's diverticulum was the cause of the pancreatitis in my first case, the one that recovered after operation, we must conclude that it passed the papilla, probably during the attack, for it had produced no symptoms from the time of the operation, May, 1890, until June, 1895, when he was examined in the hospital by Dr. Bloodgood. I find that I misinformed Dr. Körte [6] when I wrote him that my recovered case had had a subsequent attack. The attack referred to occurred in another case, one of suppurative pancreatitis, operated upon and cured by my associate, Dr. Finney.

[6] Körte: Die chirurgischen Krankheiten und die Verletzungen des Pankreas. Deutsche Chir., 1898, p. 171.

CLOSURE OF THE CYSTIC DUCT AFTER EXCISION OF THE GALL-BLADDER[1]

To close the stump of a cystic duct after cystectomy in such a way that it will not leak during the process of healing is a matter which will surely interest all surgeons experienced in the surgery of the bile passages. A biliary fistula worries and often weakens a patient, and reminds the surgeon most unpleasantly that the surgery of the bile passages is not a closed chapter. I cannot quite agree with Kehr, who well deserves to be recorded as an authority in this branch of surgery, that a biliary fistula after cholecystectomy is of so little consequence. Nor do I believe that the drainage of the stump of the cysticus with the expectation of a fistula is an ideal surgical procedure. Furthermore, from our comparatively small experience, I should not suppose that it would be necessary to drain a ductus hepaticus in about 37 per cent of all operations for gall-stones.[2]

So the temptation to close the cystic duct in certain cases is irresistible. Last spring, with this object in view, I made a cuff from the outer coats of the cystic duct, but the cuff was too short to satisfactorily effect a solid closure of the ligated and sutured duct. It was my intention to make this cuff long enough at the next cystectomy. In the meantime Dr. Finney has carried this plan to its limit and has enucleated the gall-bladder, as well as the cystic duct. So successful was he that in one of the two cases, which he has tonight reported, he confidently closed the abdomen without drainage. Kehr would as confidently predict a second operation for a certain portion of cases so treated, and last year he still urgently recommended drainage, not only of the wound, but also of the bile passages. Mayo Robson, in his book "Diseases of the Gall-Bladder and Bile Ducts," describes a procedure which probably embraces mine and Dr. Finney's also. He speaks of stripping the *peritonaeum* from the top and back of the gall-bladder and from the entire circumference of the cystic duct, and utilizing this coat to cover the stump of the cystic duct in cases of excision of the gall-bladder. As he could hardly make a flap of peritonaeum only, it is likely that he would

[1] Remarks in discussion of Dr. J. M. T. Finney's paper, "Excision of the gall bladder." The Johns Hopkins Hospital Medical Society, Baltimore, October 7, 1901. Johns Hopkins Hosp. Bull., Balt., 1902, xiii, 54-55.

[2] "Of 84 laparotomies for gall-stones there were 28 simple cholecystectomies and 31 combined with drainage of the hepatic duct." Kehr: Verhandl. d. d. Gesell. f. Chir., 1900, Teil ii, p. 172.

do what Dr. Finney did in the two cases reported tonight. It is possible that William J. Mayo, in excising the mucous membrane of the gall-bladder, would take about the same route between the coats. The thickness of the peritonaeo-fibro-muscular flap would vary considerably.[3]

Some sure and simpler method must be devised for determining positively the presence of stones in the ductus choledochus after excision of the gall-bladder.

[3] In a case recently operated upon by me, it was so difficult to enucleate the gall-bladder that I twice entered it, before and behind on the same parallel, but could easily strip a flap from the cystic duct; with this I effected a satisfactory closure, but I thought it safer to drain down to the stump.

THE OMISSION OF DRAINAGE IN COMMON-DUCT SURGERY[1]

I have welcomed the important communication of Drs. Richter and Buchbinder on this subject in *The Journal,* December 6th. Although undoubtedly not giving the last word, the authors serve the good purpose of stimulating controversy on the vital subject of drainage of the common bile duct—a subject which in greater part surgeons the world over seem to regard as settled.

The authors emphasize the desirability of closing the abdominal wound without drainage in order to avoid adhesions, taking it for granted, I presume, that it would be superfluous to call attention to the much more serious and occasionally disastrous results which follow the prolonged loss of bile by way of the incision into the common duct. To surgeons who are not prepared to follow the example of Drs. Richter and Buchbinder *I would recommend drainage of the common duct by a small tube passed well into it through the cystic duct.*[2] This is the method practised by me at present. The incision into the common duct is closed with great care and the line of suture tested by injections through the tube in the two ducts. On the third or fourth day the tube is clamped and, if the bile is found to pass freely into the ductus choledochus, is removed. Usually the leakage thereafter of bile is insignificant in amount; there may even be merely a slight stain on the first dressing after removal of the tube.

All that we gain as a rule by drainage of the bile duct is relief of tension. This relief is afforded by drainage by way of the cystic duct and tends to insure prompt healing of the line of suture of the common duct. Aside from the deplorable condition of the patient brought about by the great loss of bile, it seems irrational to me to place a drain in the infected common duct through the line of the incision into it with the expectation that primary healing of the wound in the duct will usually take place. Unquestionably the entire line of suture, contaminated inside and out with pus-producing organisms and further imperiled by the presence of the tube, has in many instances broken down.

Very slim cigaret drains (three or four or more) should surround the tube in the cystic duct and be removed with it on the third or fourth day.

[1] Letter to the Editor in which Dr. Halsted for the first time describes drainage of the common duct through the cystic duct.

J. Am. M. Ass., Chicago, 1919, lxxiii, 1896-1897. (Reprinted.)

[2] For detail of this procedure refer to Dr. Mont Reid's paper.

The gauze tips which serve to hold the drains in place should project hardly if at all beyond the gutta-percha shell. Such drains may be removed without distress to the patient. The suggestion of Dr. Follis to rotate them on their long axis when beginning their extraction is a helpful one. The sinus leading to the cystic duct should be sterilized with bismuth paste or other antiseptic. I would warn against the use of Dakin's solution in so fresh a sinus lined by intestines. The results obtained by Dr. William C. Lusk by the persistent and frequent use of an antiseptic in the treatment of rectal fistula are significant.

PLATE XCVII

Edge of Liver Everted by an Acutely Distended Gall-Bladder.

THE UPTURNED EDGE OF THE LIVER OVER ACUTELY DISTENDED, EMPYEMATOUS GALL-BLADDER[1]

A DIAGNOSTIC SIGN OF SOME VALUE

A drawing made at the operating table about 20 years ago by the late August Horn depicts quite well the upturned edge of the liver over an acutely inflamed and distended gall-bladder (Plate XCVII). This manifestation undoubtedly has been frequently observed by surgeons, and I direct attention to it merely on account of its occasional value as a confirmatory diagnostic sign. It may be much more pronounced than in the figured instance, and this ridge can be palpated if the abdominal wall is not too tense or abnormally thick. I cannot recall having noted this upturned or everted edge in the absence of signs of infection of the gall-bladder, but am not sure that it may not occur with hydrops vesicae.

More than once this sign has enabled me in a debatable case to make the correct diagnosis. In one patient there was a nonresilient mass, larger perhaps than a man's fist, situated in the epigastrium and extending only slightly more to the right than to the left of the mid-abdominal line. Surmounting this mass was a linear, almost vertical ridge hardly 2 cm. to the right of the linea alba. The physicians of The Johns Hopkins Hospital who consulted me were inclined to believe that we had a new growth under our fingers, and I was of the same opinion until on defining this ridge the correct interpretation occurred to me. At operation the mass proved to be made up of large intestine, duodenum, gall-bladder and a drawn out lobe of liver matted together and infiltrated with inflammatory exudate. The lobe of Riedel had been tugged to the right and so rotated that its upturned edge occupied rather a longitudinal than a transverse position.

In quite a number of cases in which the liver's edge over the gall-bladder, not upturned, was free and pliable, I have been able to feel it through the abdominal wall and to raise it on the back of a finger-nail insinuated between the gall-bladder and this hepatic lip.

I make it a point in every case of suspected enlargement of the gall-bladder to test for an overlying free border of the liver, upturned or not, and have much more frequently made it out in the flat than in the everted state.

There can hardly be anything new to experienced operators in what I have said, but for physicians the drawing may have interest.

[1] Johns Hopkins Hosp. Bull., Balt., 1920, xxxi, 14. (Reprinted.)

PLASTIC SURGERY

SKIN GRAFTING[1]

The third case is one of skin grafting for the cure of a very large leg ulcer—an ulcer about 20 cm. long and about 12 cm. wide at its widest part. Our method of grafting ulcers differs somewhat from that of Thiersch. Thiersch scrapes the ulcer with a Volkmann's spoon and plants his grafts on the scraped and necessarily infected surface. The surface being infected he is obliged to change his dressings daily for about one week. We cauterize the ulcer with crystallized carbolic acid and then excise it, taking great care not to infect the fresh surface which we have made. The grafts are then planted on this clean surface. This method enables us to leave the first dressing undisturbed for one week or longer.

You will observe that all of the grafts have taken in this case, and the ulcer which has existed for 14 years is now entirely healed and covered by a new and pliable skin.

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, October 20, 1890.

Johns Hopkins Hosp. Bull., Balt., 1890, i, 111-112.

CICATRICIAL JAW ANKYLOSIS[1]

My first patient is a boy 14 years old with cicatricial jaw ankylosis—ankylosis spuria mandibulae. The mucous membrane of the left cheek, of the entire molar pocket was destroyed by mercurial inflammation when he was two years old. The alveolar borders of both jaws on the left side were united by dense cicatricial tissue from the molar fornix to the canine teeth.

The boy has been operated upon several times without success. When he presented himself to me a few days ago he could not open his mouth wide enough to admit a goose quill. Four days ago I operated upon him as follows: The skin of the cheek was divided back to the anterior edge of the masseter muscle. A jaw speculum was introduced and forced open as the adhesions between the alveolar borders were divided. We succeeded in opening the jaw wide enough to easily admit a cork about 3.5 cm. deep between the incisor teeth. *The fornix of the V-shaped gap in the cheek and a small portion of both alveolar borders were then covered by mucous membrane taken fresh from the mouth of a dog on an adjoining table.* The transplanted mucous membrane which you now see in the mouth of the boy is held in place by buried stitches. I am in hopes that the grafting may be successful for we cannot pass a probe between the graft and the surface upon which it has been grafted.

I show you this case, although the result is still uncertain, in order that you may have the opportunity to watch the changes which will take place in the transplanted mucous membrane, provided that the experiment proves to be a successful one.

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, October 20, 1890.

Johns Hopkins Hosp. Bull., Balt., 1890, i, 111-112.

SPURIOUS ANKYLOSIS OF THE JAWS[1]

(This case was first reported in the preceding article.) Dr. Halsted exhibited a patient upon whom he had operated successfully for the cure of spurious ankylosis of the jaws, and said: This little boy, aet. 14 years, was profoundly salivated when he was five years old. The ulceration from the mercurial inflammation was so extensive that all of the mucous membrane lining the left cheek was destroyed. Several pieces of bone were exfoliated from the upper and lower jaws on the left side. In two years the sores were completely cicatrized. During the entire process of cicatrization the boy wore a piece of rubber between his teeth. Notwithstanding this precaution the boy could not separate his incisor teeth more than 1 cm. when he presented himself six years ago to a Baltimore surgeon for operation. The operation was not a successful one, for, when admitted to this hospital, October 13, 1890, the incisor teeth could not be separated more than about 0.5 cm. We have performed three operations upon the boy and now he is permanently cured.

Operation I, October 16, 1890.—An incision, from the left angle of the mouth to the anterior border of the masseter muscle, was made through the skin of the cheek and through the dense connective tissue which bound the jaws together from about where the canine teeth might have been back to the anterior border of the ramus of the lower jaw. We were then confronted with two raw triangular surfaces which we had made. These surfaces, one above and one below, were, of course, parallel to each other until the jaws were forced apart. The jaws having been forced apart, the planes of these surfaces had an inclination of about 45°—the bases of the triangles meeting at the fornix of the jaws, and the apices, corresponding to the angle of the mouth, being widely separated. *A large piece of mucous membrane taken fresh from the cheek of a dog was transplanted to the raw triangular surfaces and held in place by stitches.*

October 27th.—For seven or eight days it seemed as if a portion, at least, of the transplanted mucous membrane had become attached, but today *it is certain that the entire graft is dead.* It is accordingly removed.

Operation II, November 4, 1890.—The granulations covering the triangular surfaces were shaved off with a scalpel and the fresh raw surfaces were covered according to Thiersch's method with three or four grafts of skin. The grafts were held in place by fine needles used as tacks. The gutta-percha tissue and the gauze pads were also held in place by the needles.

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, February 2, 1891.

Johns Hopkins Hosp. Bull., Balt., 1891, ii, 62-63

November 8th.—The dressing is removed. The grafts have taken perfectly.

December 1st.—The boy can separate his incisor teeth about 3.5 cm.

The ankylosis mandibulae is permanently cured; for the raw surfaces have been so completely covered with skin that no adhesions and no contractions can take place.

Operation III, December 2, 1890.—To close the cleft of the cheek, a horizontal incision was made through the skin of the left cheek a little below the inferior margin of the left orbit. From the extremities of the horizontal incision two vertical incisions were made. The anterior vertical incision extended to the angle of the mouth; the posterior to the outer extremity of the cleft in the cheek. The flap of skin so defined was reflected down to close the defect in the cheek. The skin surface of the flap was turned towards the mouth, and the raw outer surface of the flap was covered with skin, transplanted according to Thiersch's method.

The boy can now, as you see, open his mouth quite naturally. I am sure that he is permanently cured. I think that the case is one well worth presenting to the society; for such cases are rarely much benefited by operation, and this case has been cured by a new and not very difficult method.

OSTEO-PLASTIC OPERATIONS FOR THE OBLITERATION OF A VERY LARGE INVOLUCRAL CAVITY[1]

John McCarthy, aet. 56, was admitted to the hospital, July 7, 1891. About two years ago he sustained a severe bruise of the left leg. A month later there developed in the typical way an acute osteomyelitis of the left tibia. Within three months of the onset of the attack the pus had made its way through the soft parts in several places. In the course of the following nine months several small pieces of bone escaped through the openings in the skin. Thereafter and for about one year the patient was able to work and to walk, and was quite free from pain.

About four months ago he was again seized with pain in the left leg. An abscess formed rapidly in the upper end of the tibia and perforated the skin at a new point about 8 cm. below the knee joint.

Operation, July 10, 1891.—An incision to the bone was made from just below the knee joint to just above the ankle joint. The anterior wall of the unusually thick and eburnated involucrum was chiseled away. The sequestrum had been almost completely absorbed. The involucral cavity was so very large and its wall so hard that the chances for the organization of a blood clot seemed to be very few. I decided, accordingly, to attempt an osteoplastic operation. The involucrum was split longitudinally from its lower end to within about 5 cm. of its upper end. From the ends of the longitudinal cut in the bone transverse cuts were made from without inwards through the involucrum. A bone flap about 18 cm. long and 4.5 cm. wide, and still adherent to its periosteum, was thus defined. Having beveled the outer edge of this flap and the contiguous edge of the involucrum, the flap was without difficulty folded out so that the edges of its slightly concave surface rested on the almost plane surface of the involucrum. The apposed surfaces were then planed with the chisel and the bone flap was held in place by a few stitches. The wound was then allowed to fill with blood.

The dead space in the shaft of the bone was greatly diminished in size, although not completely obliterated. In the head of the tibia the dead space was still a very large one.

[1] Presented at The Johns Hopkins Hospital Medical Society, Baltimore, October 5, 1891.

Johns Hopkins Hosp. Bull., Balt., 1891, ii, 160-161.

September 25th.—The plastic operation was a success. The bone flap certainly served its purpose, for the involucral cavity is obliterated as high as the top of the bone flap. But above this point—from the top of the bone flap to within about 2 cm. of the knee joint—there is a cavity large enough to receive a lemon, lined by low and feeble granulations.

Second Operation, September 26, 1891.—The cavity in the head of the tibia was almost completely obliterated by the turning in of two short bone flaps—one from the outer and one from the inner side.

[*November 20, 1891.*—The second operation was also a successful one. There is firm union between the bone flaps and the wall of the cavity, but there is still a very narrow crevice between the flaps which the granulations are too feeble to obliterate. A third operation will, therefore, be necessary. This is a case which certainly could not have been cured by the blood clot method alone.]

The dense bony wall of the cavity was not able to furnish granulations vigorous enough to supply even the small clot which occupied the narrow crevice between the two small bone flaps in the head of the tibia, and has not in two months contributed much towards the obliteration of this little space.

I am quite sure that we shall by this method be able to obliterate easily many of the large old involucral cavities which might be intractable to other methods of treatment. The cosmetic effect of the osteoplastic operations just described is, as you see, exceedingly good. The tibia has been restored very nearly to its natural proportions. It has neither the greatly disfiguring, boat-shape which characterizes the much employed inverting method (Neuber's Einstülpungsmethode) nor the great size which attends the employment of the blood clot, decalcified bone and similar methods.

THREE CASES OF PLASTIC SURGERY[1]

Plastic Operation for Extensive Burn of Neck

This patient was very extensively and terribly burned about a year ago over the chest, neck and arms. She was greatly disfigured and tortured by it. Her head was drawn down to the chest, the chin being bound to the sternum by a short, thick, fibrous cord. Her left arm was bound to her side. She had been operated upon before coming to us, but without success. When she came to this hospital it was evident that a number of operations would have to be done. Her patience and fortitude are remarkable, and I believe that she would be willing to be operated upon as long as we felt that the condition could be improved. I am sure that we have already restored her head to an entirely satisfactory and quite normal position, and that she will have perfect restoration of motion and function. I wish to call especial attention to the fact that we have "waltzed" (to use a pertinent expression) a flap of skin from the side and back of the neck to the front of the neck. None of the original attachments of the last flap which we used have been preserved. The flap has twice been twisted upon itself; first upon a small pedicle of skin, original tissue we may call it; and, secondly, upon a little broader pedicle of cultivated cicatricial tissue. The flap has probably made a complete revolution. Its circulation, as you see, is excellent. It is certain to live. On two different occasions, both prior to this last operation, we secured flaps from the two sides of the neck and shoulder, and drew them forward to the middle line. Both flaps crossed the middle line at first, but receded eventually, so that at the time of this last operation the two flaps did not quite meet in the middle line. Between them was a bridge of cicatricial tissue about one-half inch in depth (from before backwards) and possibly one and a half inches broad and one and a half inches from above downwards. Her head, although in a very much better position than formerly, was still bound to the chest by this powerful cicatricial band, and was not in a satisfactory condition either to her or to us. We cannot regard the primary operations as simply preparatory to the final ones, for we had substituted normal skin for cicatricial tissue at the lateral and antero-lateral neck regions, and thereby, as I have said, decidedly lessened her discomfort. At the last operation, performed seven or eight days ago,

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, November 4, 1895.

Johns Hopkins Hosp. Bull., Balt., 1896, vii, 25-26.

we made a flap from the front and right side of the neck, employing for this purpose the skin which at the first operation we had brought forward from the postero-lateral neck region. This flap now occupies the middle line of the neck in front. Its only attachment at the end of this last operation was a new one of cicatricial tissue which it had formed subsequent to the first operation. We did not confine ourselves to the flap-tissue at the last operation; in some places we did not take all of the original flap, and in other places some of the original tissues beyond the flap were taken. The surfaces denuded by the making and twisting of the flap were immediately covered by skin grafts. The grafting, as you see, has been entirely successful. We can perceive that it would be possible in every conceivable case to get a good result from this method of skin transplantation. One might, if desirable, rotate a flap from the thigh to the neck.

Plastic Operation for the Closure of a Fistula

Our second patient, a man about 40 years old, had a round-cell sarcoma of the floor of his mouth which clinically also seemed to be very malignant, and which necessitated the removal of a large portion of the tongue, jaw, floor of mouth and neck. A very extensive operation was performed in January, 1894, nearly two years ago, and he has had no signs of recurrence. I show him because he, too, is a plastic case. The plastic operation which we subsequently did in his case was to close a fistula by a method which in our hands has several times been attended with excellent results. It is probably an operation which is well known to gynaecologists, but I have never seen it described. A circular incision is made through the skin or cicatricial tissue a few millimetres from the margin of the fistulous opening; a little flap is dissected up all around this opening and then turned in by two layers of continuous suture. The orifice is thus completely blocked by tissues which present broad raw surfaces to each other, and also a raw surface to a flap of skin which is then produced from the immediate neighborhood and twisted over it. I should be glad to have Dr. Kelly tell us if this method has been used by him to close vesico-vaginal fistulae.

A Case of Epispadias

The third patient, a man aged 50 years, had, on admission, a complete epispadias. I show this case because we have done in one operation what often takes from four to six and sometimes, it is said, 20 operations to accomplish. I do not think that I should have ventured to do so much at one sitting if it had not been for the confidence that I have in the buried continuous sutures of silver wire. A short flap was dissected up on each

side from the tip of the glans to beyond the bladder orifice. These flaps were inverted by two of these continuous sutures into the future urethra. Broad raw surfaces were thus brought together. The roof of the urethra was reinforced by an additional flap of skin from each side. The reinforcing flaps were sewed right side out, whereas the original flaps were sewed wrong side out. The only sutures were three superimposed continuous ones of silver wire—two in the inverted flap and one in the reinforcing flap. It is customary to perform a special operation for the glans, and subsequently another for the body of the penis, and again another to close the bladder, and finally several to connect the parts separately closed in. The result in this case has been excellent. The wound has healed throughout; but a very small subcutaneous abscess formed at the end of the first week which we opened to the right of the line of suture. Consequently there is now a minute opening, near the root of the penis, in the roof of the urethra which may require a second operation. The patient has already an excellent urethra and passes his urine entirely by the new channel and through the new meatus if he covers with the tip of one finger the little hole made by the knife in the roof of the urethra. We shall, if necessary, close this hole by the method employed in case two. Please observe that the linear scar, which is all that there is to suggest that an operation has been done, is scarcely perceptible. Only a very close observer would suspect that an operation had been performed upon this penis, and I doubt if any one could tell the precise nature of it.

REPLANTATION OF ENTIRE LIMBS WITHOUT SUTURE OF VESSELS[1]

The experiments were undertaken with view to determining the amount and duration of the swelling which would result from the division of all the vessels and lymphatics of a limb, our interest in the subject arising from the desire to obtain experimental support of the contention that permanent swelling of the arm following operations upon the axilla is probably invariably due to infection,[2] an infection often so slight as to escape the observation of the surgeon. It is almost a daily experience of active surgeons to see swollen arms as result of radical operations for cancer of the breast. The swelling is frequently so great as to cause suffering and disability from the weight of the arm, and occasionally patients have consented to amputation of the entire limb for the condition which surgeons have been powerless to relieve. The ordinary swelling is universally attributed to the removal of the axillary lymphatics and veins, and some surgeons have advocated operations less thorough, believing that their results as regards the swelling of the arm have been better when the axilla was less meticulously cleaned.

For many years we have been impressed with the fact that infection, however slight, after radical operations for cancer of the breast was likely to be followed by more pronounced swelling of the arm and that the largest arms were noted as a rule in cases in which the inflammatory reaction and the axillary induration were greatest. We assumed, naturally, that the excessive swelling must be due to the blocking of lymphatics and possibly veins uninjured by the knife.

About 13 years ago a modification of the operative procedure was made, particularly in the manner of closing the wound, and thereafter, to our

[1] By Halsted, W. S., Reichert, F. L., and Reid, M. R. The complete paper with illustrations will be published elsewhere by Dr. F. L. Reichert. Dogs were always operated upon while under the influence of ether anaesthesia.

Presented before the National Academy of Sciences, Washington, D. C., April 24, 1922. Also presented before the American Surgical Association, Washington, D. C., May 2, 1922.

Proc. Nat. Acd. Sc., Easton, Pa., 1922, viii, 181-186. (Reprinted.)

Also: Tr. Am. Surg. Ass., Phila., 1922, xl, 160-167.

Also: Lyon Chirurg., Lyon, xix, 369-376.

[2] W. S. Halsted: The swelling of the arm after operations for cancer of the breast—*Elephantiasis chirurgica*—its cause and prevention. Johns Hopkins Hosp. Bull., Balt., 1921, xxxii, p. 309.

surprise, swollen arms became almost a thing of the past. I say "to our surprise," for the modifications in the operation were made primarily merely in the hope of securing greater freedom of motion at the shoulder joint.

Now inasmuch as the destruction of lymphatics and veins was identically the same in the modified as in the original procedure, we concluded that the most thorough excision of the axillary contents could not alone produce swelling of the arm, and that whatever the predisposing cause might be, the ultimate factor in the production of the swelling must be something which had been eliminated in the newer procedure.

It is a common observation that a moderately swollen arm may after an interval of a year or more become markedly increased in size. This augmentation is generally and quite properly attributed to a recurrence of the disease. Occasionally, but rarely, we have observed an arm that for a year or more after the operation had maintained approximately its normal size swell quite acutely. The swelling might follow closely upon constitutional symptoms—nausea, malaise, chill and fever—and be coincident with a slight or even bright blush of the skin of the shoulder, arm, and perhaps chest and forearm.

For example, in May, 1920, a patient upon whom Dr. Halsted had performed at The Johns Hopkins Hospital a radical operation for mammary cancer in November, 1916, consulted him in regard to an acute swelling of the arm on the operated side. The arm had maintained its normal size prior to an "attack" in February, 1920, in the course of her convalescence from influenza. This attack as she terms it was ushered in by nausea, a chill and high fever. The arm promptly began to swell and there appeared "redness in streaks" from the shoulder to the wrist; in a few days the redness was diffuse and the swelling of the arm had become distressingly great; the hand, she said, resembled a "boxing glove," and pressure on it with the fingers produced "deep pits." In eight or ten days the redness had vanished and the swelling was decreasing. During the three months prior to this her second admission to The Johns Hopkins Hospital there had been a less rapid reduction in the size of the affected (left) limb, which about the middle of the arm measured in circumference 9.5 cm. more than the other, and at the middle of the forearm, 3.5 cm. more. No glands were palpable above the clavicle, and there seemed to be no abnormal fullness or resistance below it. In the skin at the outer-upper edge of the grafted area there was recurrence of the carcinoma—two nodules, not ulcerated, one about the size of a filbert, the other smaller than a split pea.

The immediate cause of the swelling was undoubtedly the local infection, for during the three years and three months prior to this and subsequent to

the operation there had been nothing to indicate a blocking by recurrent disease of the lymph channels.

Eight days after the second admission (June 1, 1920), the patient was operated upon by Dr. Mont Reid, then resident surgeon. The second and a part of the third portion of the axillary vein were found to be completely occluded by the new growth, which was continuous with the larger of the two cancerous nodules in the skin. The axillary vein and the recurrent growth were excised in one piece, the disease being given a wide berth. On examination of the specimen it seemed quite clear that the vein had been invaded from without, and had surely been occluded long before the attack of infection. After this operation the swelling rapidly subsided and in the course of two months the arm had almost regained its normal dimensions.

In this case, as in a number of others observed in our clinic, the occlusion of the axillary vein plus the excision of the axillary lymphatics was not followed by any swelling of the arm.

We have under observation several patients who each year following the operation have had one or two or more attacks of the kind described, each attack being followed by an increase in the size of the arm.

Only four days ago we received an announcement of the death of a patient whose story subsequent to an operation for cancer of the breast sustains the view that swelling of the arm may be due to infection even when local and general signs of inflammation are wanting. This patient was operated upon by Dr. Halsted five years ago. About nine months after the operation she consulted him in regard to a rather acute but inconsiderable swelling of the arm on the affected side, which theretofore had not been swollen. She could not recall having had constitutional symptoms and was quite sure there had been no inflammatory redness of the arm coincident with the first appearance of its enlargement. From the time of this interview until her death, four years and three months later, there had been no augmentation of the swelling. She died of carcinomatous metastases in the bones. There was no recurrence of the disease either locally or in lymphatic glands which could have affected the circulation of the arm. Hence the swelling which occurred nine months after the operation could not have been due to the blocking of lymphatics by cancer.

Operations upon the glands of the groin may be followed by elephantiasis of the scrotum. One patient in this category was operated upon by Dr. Halsted in New York about 40 years ago. During all this period he has each year had mild local attacks of an infection resembling erysipelas and with each attack a slight, transient, increase in the elephantiasis.

Now if redness or even a faint blushing of the arm always accompanied the advent of the swelling which occurs after an interval the discovery

1.—Dog A 22. Sixteen Days After Replantation of Hind Leg. Nine Days After Ligation of Femoral Vein.

2.—Dog A 23. Six Days After Replantation of Hind Leg. One Day After Ligation of Femoral Vein.

1.—Dog A 23. Twelve Days After Replantation of Hind Leg. Seven Days After Ligation of Femoral Vein.

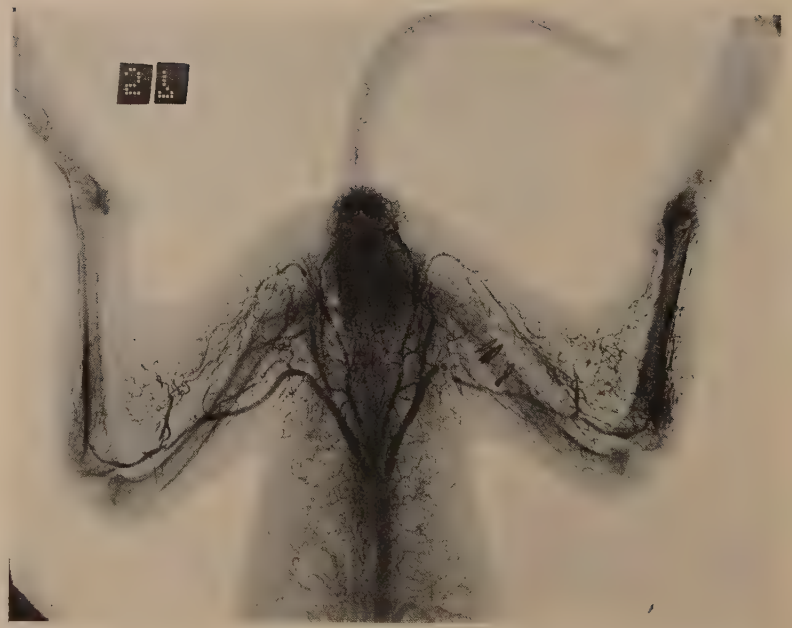
2.—Dog A 24. One Day After Replantation of Hind Leg.

1.—Dog A 25. Seven Days After Replantation of Hind Leg. Two Days After Ligation of Femoral Vein.

2.—Dog A 26. Two Days After Replantation of Hind Leg.

PLATE C

1.—Dog 8 E. November 1, 1920, Amputation and replantation of left leg (Reid). November 11, 1920. Ligations of right femoral artery and vein proximal to profunda vessels (Reichert). June 6, 1921 (7 months after the ligations). Amputation and replantation of right leg; femoral artery and vien found reduced to fibrous cords. June 22, 1921 (16 days after the replantation of right leg). Dog sacrificed and arteries injected with bismuth.



2.—Dog A 17. Operation I, January 25, 1922. Amputation and replantation of left leg. All structures were divided except the femoral artery and vein; bone wired; nerve not sutured. Operation II, February 11, 1922 (17 days after replantation). The femoral artery and vein were ligated. Operation III. Rewiring for breakage of wires. February 24, 1922 (30 days after replantation and 13 days after the ligations). Animal sacrificed and arteries injected with bismuth.

would undoubtedly have been made long ago of the relationship of infection to the swelling of the arm. But an infection quite negative in external manifestations other than swelling may, we believe, exist and suffice to produce the further blocking which in our opinion is essential to the production of the swelling.

In a word, then, we have thought it unlikely that the excision of the axillary contents, lymphatics and veins, could alone be responsible for the swelling of the arm which is observed after the radical operation for cancer of the breast in nonrecurrent cases.[3]

Thirty-five years ago (in 1887) in the laboratory of Dr. Welch, Dr. Halsted successfully transplanted the hind leg of a dog from one side to the other, leaving however the main artery intact for a few days—until union between the muscles and other divided tissues had taken place. And in more recent times (1907) Carrel, with the aid of his vascular suture, made the remarkable discovery that the leg from one dog can be transplanted to another.

At the outset of our experiments[4] we had it in mind merely to determine the amount and duration of the swelling which would follow the division of all the lymphatics and veins of the thigh. At the primary operations all the soft tissues except the femoral artery and vein and the sciatic nerve were divided and immediately reunited by suture. On the second day after the replantation the femoral vein was tied in two dogs; in one of these gan-

[3] We were greatly pleased a few weeks ago to have our attention called by Sir Almroth Wright to the following paragraph in his paper entitled: "Introduction to Vaccine Therapy." "Lastly—for it is impossible to mention all the points, streptococcic infection would appear to be responsible for that swelling of the arm so often seen after amputation of the breast—that swelling which finds, as we are told, a perfect explanation in the 'mechanical blocking of the lymphatics.'" (Nelson Loose Leaf Medicine, 1920.)

We quote the following from another of his letters to Dr. Halsted: "I am convinced that you are right as to its causation, and sharing that view I have when I was in practice before the war treated some half dozen of these cases with streptococcus vaccine. I think one may be enthusiastic about the results, at any rate in many cases. I shall never forget the surprise of a doctor's wife who had had one of these swollen arms for years and came back triumphant because she had seen the bone in her arm for the first time for years. She meant that the bony contours about the elbow had come to stand out clearly where before there had been a mere formless swelling. Some day I hope to get it accepted that it is a feature of cancer to be infected with staphylococci and streptococci quite early, long before it has eaten through its way to the surface, and I have seen great relief and reduction in size in such tumors by inoculation. That is the germ of truth in Doyen's doctrine of *Micrococcus neoformans*."

[4] The operative work in the current experiments was done by Dr. F. L. Reichert, Dr. Mont R. Reid and Dr. C. Y. Bidgood. The arterial and lymphatic injections, the preparation of the specimens, the X-ray studies are all the work of Dr. Reichert.

grene promptly followed the ligation. Then on the fourth day after replantation the experiment of ligating the femoral vein was twice made; gangrene resulted in one of these dogs. Ligations on the fifth, sixth, seventh, ninth and eleventh days and at later periods have not been followed by gangrene; and if performed as late as the ninth day, by little or no increase in the size of the limb. Replantation and simultaneous ligation of the femoral vein was invariably followed by gangrene—six cases.

In one case the femoral artery and vein were ligated simultaneously with the replanting—gangrene followed. Both femoral vessels may be safely ligated on the sixth day, and probably earlier.

As the possibility of an anastomotic circulation by way of the bone and sciatic nerve naturally occurred to us, Dr. Reid, in one dog, divided these structures as well as the others. The replantation was successful.

In one instance the replantation was successful notwithstanding the fact that the femoral artery and vein had become totally obliterated by ligation of these vessels seven months previously. The story of this case is as follows: November 1, 1920, Dr. Reid replanted the left hind leg of a dog. Ten days later Dr. Reichert ligated the femoral artery and vein of the opposite (right) leg for the purpose of making X-ray studies of the anastomotic circulation. On June 6, 1921, seven months thereafter, Dr. Bidgood and Dr. Reichert amputated through the right thigh of this dog—bone undivided, having forgotten that the main vessels of this leg had been previously tied. They were surprised to find that these vessels had become converted into fibrous cords and naturally feared that the replanted leg would become gangrenous. Finding later that the leg would live, we regretted that the obliterated vessels had not been severed. Hence a portion of each of the fibrous cords was excised (Reichert) and examined microscopically. Not only had the lumina become obliterated but the strands consisted of nothing but white fibrous tissue, the muscle and elastic tissue of the coats having disappeared. Whatever may be the explanation of this successful replantation in one act, the result is remarkable—almost beyond belief. This experiment will of course, be repeated, many times if necessary, and Dr. Reichert has made the preliminary ligation of the femoral artery and vein in a number of dogs with the intention of practising the amputation and replanting at various periods thereafter.

An unusually perfect technique is essential for the successful conduct of such experiments. Were it not for the fact that well-nourished tissues can take care of many organisms, few wounds would heal by first intention. But in the replantation experiments unusual precautions have to be taken for the reason that a devitalized limb presumably has little power to resist infection. Of the two surfaces which we are asking to unite, one is for a

time quite dead if all the structures have been divided. When the artery and vein have been left for secondary ligation, little imperfections in technique need not be disastrous. The impossibility of having up to the present time an absolutely perfect technique may possibly account in part for the fact that the replantations have not succeeded when all the structures have been divided except in the one instance. It is, however, astonishing, I may say hardly believable, that the complete replantation should have been successful after and even after the preliminary ligation of the artery and vein. Having once been accomplished, an occasional repetition of the success may safely be predicted. With a technique still further perfected we might find that without preliminary ligation of the main vessels a complete replantation is occasionally possible.

After 16 days and probably earlier the new lymphatics crossing the scar are demonstrable by injection. This is perhaps the most convincing functional proof we have of the regeneration of lymphatics.

On the sixth day the femoral artery and vein may, as stated above, be safely ligated. Hence on the sixth day or earlier the entire circulation of the leg is carried on through the newly-formed vessels—lymphatic, venous, arterial.

On the 12th day the swelling, which increases during the first week after replantation, has about disappeared.[5]

[5] Lantern pictures illustrating Dr. Halsted's improved method of operating for cancer of the breast, of the dogs at various periods after the replantation and of skiagrams of the injected newly-formed arteries were exhibited.

MISCELLANEOUS

TWO CASES OF REFLEX NERVE MANIFESTATIONS CURED BY OPERATION[1]

Dr. Halsted presented a patient whose ulnar nerve he had recently stretched for the relief of painful spasms of the muscles of the hand, forearm and arm, and, apropos of this case, reported two others operated upon by him for the relief of reflex nerve manifestations.

Case 1.—Presented. Wm. A. Leslie, white, aet. 33. Eight to nine years ago he was kicked on the inner surface of the right elbow, causing intense pain with contraction of the hand. The hand was useless for nearly a year on account of stiffness and pain. After this he regained some use of his arm, but had frequently recurring spasmodic pains and contraction of the fingers upon any slight strain, compelling him to stop work for a week or two at a time.

In April, 1888, the same elbow was caught in machinery and the symptoms recurred in an aggravated form. The severity of this attack also passed off. Last September the patient fell from a wagon striking the elbow again, the same symptoms recurring with increased severity. The hand grew purple, the arm swollen, the contraction of the fingers stronger and the spasms frequent and very painful.

Ever since the first injury, but especially after the last, he has had tremor of the affected arm.

On admission the arm was not appreciably wasted. The fingers were flexed at the metacarpophalangeal and interphalangeal joints. The fingers could be straightened by passive movements, not, however, without causing a good deal of pain referred to the site of the injury.

There was a constant, fine, rhythmical tremor affecting the hand and, to less extent, the arm. Any voluntary effort increased this tremor or, indeed, if the arm was even raised passively the tremor was increased.

All voluntary movements of the arm caused pain, but there seemed to be no paralysis. The contracted fingers could not be voluntarily extended. The sensation tested with regard to touch, pain and temperature, was subnormal over the whole arm; most marked on forearm and dorsum of hand. The change did not follow the distribution of any nerve. All the nerve trunks were painful to pressure, the ulnar could be felt just back of the olecranon and was extremely sensitive.

November 23d.—Under ether the ulnar nerve was laid bare for about four inches and stretched with fingers both upwards and downwards. The wound was closed with buried skin sutures of silk.

[1] Presented before The Johns Hopkins Hospital Medical Society, Baltimore, December 2, 1889.

Johns Hopkins Hosp. Bull., Balt., 1890, i, 35-36.

For three days after the operation, the patient had considerable pain in the region of the wound and the right shoulder, but it was not spasmodic and did not resemble the pain experienced before the operation. After this he had no discomfort worth noting.

On the eighth day the wound was dressed and found to have healed by first intention. On the ninth day (when the case was presented) the contraction had disappeared. There was no tremor. Voluntary motion was free and caused neither pain nor tremor. Sensation was everywhere normal. There was a slight sense of numbness in the little and ring fingers.

Case 2.—Cranial neuralgia and reflex mental disturbance cured by the excision of filaments of the supraorbital nerve. Mary Frisbie, colored, aet. 10 years. Two years ago the patient fell from a cart, striking and causing a small depressed fracture at the outer side of the left frontal eminence. No physician was called and the wound healed in three or four weeks. Since that time, during hot weather, and at intervals of two or three weeks, the patient would have frontal headache at night, occasional neuralgic pains on the left side of the face, throbbing in the head and tinnitus aurium. The next day, if not watched, she would escape from the house and, evading all pursuit, run off, being caught only when tired out. At such times she is said to have had a "wild look in her eyes," to have run very swiftly and to have used various means for preventing her capture. The next day she would profess no knowledge of the matter. During the intervals, she had shown no abnormal symptoms except an inability to endure loud noises, such as school children reading in concert, on account of the "throbbing" and "singing" which the noises cause "in her head."

The attacks seldom occurred in cold weather; the warmer the weather, the more frequent they were. There was a small scar on the outer side of the left frontal boss and pressure revealed a slight triangular depression beneath the scar.

August 27th.—Under chloroform followed by ether, a small flap, including the scar, was dissected up over the left eyebrow, and a few filaments of the supraorbital nerve resected. On the 11th day the patient left the Hospital to report at the dispensary. She has recently returned, her mother reporting the complete absence, since her discharge, of any of the symptoms for which she was treated.

Case 3.—Cranial neuralgia and tinnitus aurium of nine years duration cured by excision of the suboccipital nerve.

Mrs. I., aet. 36. Consulted Dr. Halsted in October, 1885. She was suffering intensely from cranial neuralgia and from a ringing in the left ear, which latter she compared to the noise of a fire engine at work. For nine years she has been afflicted with dreadful headaches and with this ringing in the left ear. She would occasionally, for a week or 10 days at a time, be without headaches, but the ringing in the ear was quite constant and very annoying. The headache was often so severe as to lead her to believe that she would become insane from it.

She described "attacks" of pain. The pain would begin, it seemed to her, back of the left ear and from there radiate first over the left side of the head to the left eye and thence to almost every part of the head.

An attack would last from three days to two weeks or longer. She occasionally suffered from nausea, when the pain was most intense. It seemed to her as it did to Dr. Halsted that there was a very small hard nodule over the mastoid portion of the temporal bone. Pressure on this nodule caused pain which would dart forward to the left forehead. Dr. Halsted advised excision of the nodule as he believed it to be connected with the suboccipital nerve.

The patient consented to the operation but became so unnerved—perhaps from the effects of the cocaine which had been injected into the part to be excised—that Dr. Halsted was obliged to content himself with a single cut through the little tumor down to the bone.

Much to his gratification the patient was entirely relieved from her headaches for about one year. She was not, however, relieved from the ringing in the left ear. For about 11 months there was anaesthesia of that portion of the scalp which is supplied by the left suboccipital nerve. With the disappearance of the anaesthesia the headaches returned, and in November, 1886, they were quite as severe as ever. The patient again applied to Dr. Halsted for relief and was operated upon under ether. The scar from the first operation was excised and also a piece of the suboccipital nerve central to the departure from it of its auricular branch. There was no trace of the little fibrous tumor which had been observed the year before. Three or four days after this operation the patient suffered for a few hours from headache and ringing in the left ear but from that time until February, 1888, when she died suddenly of heart disease, there was no return either of the headache or of the ringing in the ear.

THE SINUS-SPUD[1]

Many times for the past 22 years I have been reminded at the operating table and in the wards of a certain remarkable case to which I have frequently referred in my clinics as typifying in an unusual and extreme fashion nature's process of local protection and repair in her combat with infection. In this period I have seen three other cases—the last one only a year ago—which, in the essential features, were almost identical with the first.

Case 1.—About 22 years ago a distinguished physician from a neighboring city consulted me in regard to a tumor which he and his colleagues believed to be a cancer of the rectum. Just before leaving home he made his will, believing that his life would soon be terminated either by operation or by the disease. He was admitted to The Johns Hopkins Hospital and the story told by the notes of his case is as follows:

Surg. No. 4949. Male, aet. 59. Admitted to The Johns Hopkins Hospital December 20, 1895. Discharged January 4, 1896.

The patient states that he first observed a tumor in his perineum about two months ago. Occasionally he has noted neuralgic-like pains in this region.

In the perineum, 1 cm. to the left of the mid-line and 2 cm. posterior to the scroto-perineal junction, the tip of a hard teat-like mass can be felt. The tumor can be traced from this point across the median line to the right side and thence backward toward the rectum and bulbo-membranous urethra. The anterior, more superficial, part lies just beneath the skin and is freely movable; the central portion is less movable, and the posterior extremity is quite fixed and deep. The mass is hard and insensitive, except on rough manipulation. Rectal examination negative.

Operation December 21, 1895 (Dr. Halsted).—A straight incision through skin and fat exposed the nearly circumscribed tumor which was composed solely of fibrous tissue. In its center was a sinus which, traced with a fine probe, was found to be about 7 cm. long. It was blind at both ends. (*Vid.* Fig. 65.) Posteriorly the tumor terminated on the aponeurosis of the levator ani muscle about at the junction of the transversus perinei and erector penis muscles. In the course of the dissection the bulbo-membranous urethra was exposed, and the fact established that the sinus had no communication either with it or with the rectum. The wound was left unclosed with the idea that any overlooked communication with the rectum or urethra might be promptly detected. But no fistula resulted.

Case 2.—The second case of what I have termed sinus-finger or sinus-spud was also a private patient at The Johns Hopkins Hospital, but, unfortunately, I have not been able to find the history and cannot recall the name of this patient. The pertinent facts, however, I remember distinctly.

[1] Johns Hopkins Hosp. Bull., Balt., 1918, xxix, 195-197. (Reprinted.)

The patient, a male, aet. about 35, was short in stature, rather emaciated and of sallow complexion. He complained of a dull pain in the right iliac fossa, but denied having had attacks suggestive of appendicitis. A very hard, rather diffuse but quite nodular mass could be palpated in the region of the appendix. I expressed to the patient's friends the opinion that he probably had a cancer, either of the cecum or of the vermiform appendix, and advised exploration. The patient had a horror of the knife and refused to be operated upon. In the course of a few months he again presented himself for examination. The mass was definitely smaller and perhaps harder; it was only slightly if at all tender and caused very little discomfort. There seemed to be considerable improvement in the patient's general condition. Withdrawing my diagnosis of cancer, I urged exploration, believing that the appendix was responsible for the trouble. The patient again declined operation, but returned in the course of, perhaps, six or eight months for observation. The mass diminished slowly in size until at

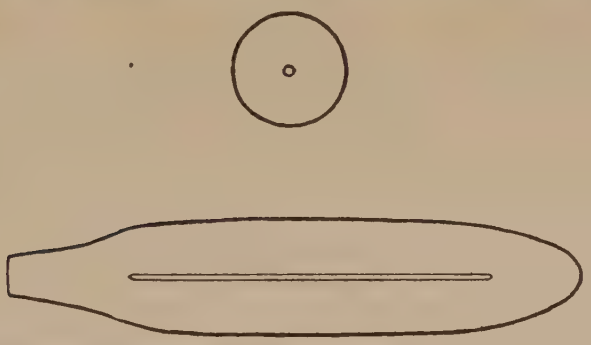


FIG. 65.—Approximate Dimensions of the Sinus-Spud and its Central Canal in Case 1; Longitudinal and Transverse Sections.

the end of about one year it resembled in form the tip of a finger. Forcible palpation of the little spud caused no pain. Of the ultimate fate of the mass or of the patient I know, unfortunately, nothing, but I am quite sure that this was another instance of a fine sinus surrounded by a finger-like bud of connective tissue.

CASE 3.—Surg. No. 11187. Male, aet. 48. Admitted to The Johns Hopkins Hospital November 16, 1900. In May, 1899, the patient had been treated for fistula in ano.

About two weeks before admission he had had quite severe pain "back of the rectum." He stated that there had been slight swelling and faint redness somewhere in this region, but he had not observed blood or pus or anything abnormal in the stools. The pain was not increased at defecation.

Examination.—In the mid-line, just posterior to the scrotum, is a hard, circumscribed, quite freely movable and slightly tender mass. Nearer the anal margin along the raphe is a little abnormally resistant and slightly reddened area. The two swellings seem to be connected by a narrow strip of indurated tissue. "Dr. Halsted described the prominence in the anterior

part of the perineum as a finger-like mass connected with the posterior area of induration by a pencil-like process."

Operation November 17, 1900.—Complete excision of the areas of induration. The excised mass consisted solely of fibrous tissue surrounding a sinus tract. In the anterior finger-like portion the sinus was very fine and its connective-tissue capsule remarkably thick. Posteriorly the sinus was wider and its fibrous envelope much thinner. There were some tiny pockets of pus and necrotic tissue in the posterior portions of the sinus. Careful search was made for a fistulous connection with the rectum or urethra, but none was found.

Observations made by the patient during urination and defecation failed to detect escape of gas or fluid or foreign matter into the wound. There was no evidence of fistula at the time of discharge from the hospital December 15, 1900. After a little more than a year (February, 1902), however, the patient returned with a perineal fistula, which communicated with the urethra.

Case 4.—Male, aet. 45, consulted me in May, 1917, for a tumor in his perineum. He stated that he had never had any urethral trouble. Two years previously he had been operated upon for haemorrhoids. About one year after this operation he had begun to be troubled with pain in the perineum.

On examination a hard, smooth, finger-like mass about 5 cm. long and perhaps 1.5 cm. broad was found in the perineal mid-line extending backwards to within 2 cm. of the anal margin. The anterior end of the mass was rounded, definitely circumscribed and not adherent to the skin, which was normal in appearance and texture. Quite forcible manipulation of the finger-like tumor caused no pain, nor did there seem to be any tenderness on deep pressure. The rectum was examined with negative result. The patient experienced no abnormal sensations at stool or during micturition. The findings altogether were, to the best of my recollection, almost precisely the same as in Cases 1 and 3. I assured the patient that the tumor was not a neoplasm, as had been supposed, and explained to him its nature. Operation was deferred on account of urgent business affairs.

About two months later, July 29, 1917, the patient consulted Dr. Follis because the mass had increased in size and become tender. Dr. Follis, who had assisted me to operate on Case 3, immediately recognized the nature of the trouble and advised excision. For some reason operation was again deferred. On examining the patient three weeks later Dr. Follis noted that the mass had entirely vanished. Incident to its subsidence there had been observed no signs of an abnormal discharge from rectum or urethra and no unusual sensations.

In April of this year (1918) the patient consulted Dr. Follis with reference to another matter and stated incidentally that there had been no return of his perineal trouble.

We may, I think, confidently assume that the nature of the tumors or spuds was the same in the four cases here recorded. In the three perineal cases the pictures were, in every particular, so nearly identical that, presumably, they had also a cause in common. In one instance (Case 3) a

urethral fistula developed two years after the excision of the sinus and its fibrous wall. Hence from this we might naturally conclude that a urethral lesion was responsible for all of the perineal spuds, notwithstanding the fact that no one of the three patients could recall having had at any time a urethritis. But this patient (No. 3) had been treated for fistula in ano a year before his perineal tumor appeared, and No. 4 had been operated upon for haemorrhoids. In the two cases operated upon by me (Nos. 1 and 3) we felt we could assert positively that at the time of operation the sinus did not communicate with either rectum or urethra. In both of these cases, furthermore, the sinus did not extend in either direction to the end of the spud. The original urethral or rectal openings must have been very minute and have become closed.

It is, I think, particularly significant that in the three perineal cases the situation of the spud was precisely the same, and the dissection in the two operated cases led to the same spot, viz., to the neighborhood of the bulbo-membranous urethra. If the three cases had been of rectal origin it is extremely unlikely that the rectal perforation would in each have been identically at the same point.

How is the disappearance of the spud in Case 4 to be explained? Did an abscess form and rupture into the urethra, or did the acute inflammatory process sterilize the chronic sinus and thus bring about absorption of the fibrous tissue and its lining? The latter explanation is, I think, the more plausible, for if an abscess had ruptured into the urethra it is likely that there would have been some indication of it either at the time or later. An analogous process is observed occasionally in atheromatous or sebaceous cysts. A wen may disappear after being inflamed; its epithelial lining becomes destroyed and the sac absorbed as a result of the infection. So, too, an empyematous gall-bladder may rapidly shrivel to a nubbin, and an inflamed appendix to a fibrous cord. Sinus tracts of years' standing heal promptly when sterilized. I recall having seen an abscess of the tongue without operation become rapidly converted into a sterile cyst with clear contents.

Correct interpretation of the condition is important, although failure to recognize the nature of the tumor could hardly be disastrous. Faulty diagnosis, however, caused three of the patients great distress.

A finger-shaped, subcutaneous tumor of the perineum, quite free at its tip and with the hardness and elasticity of cartilage, is probably a sinus-spud and may be recognized almost at the first touch of the palpating finger.

Many surgeons undoubtedly will recall transitional forms of sinus-spud—bud-like processes of fibrous tissue of various dimensions enveloping a central sinus communicating with the rectum, urethra or mouth.

SELF-EVENTRATION OF A LARGE ABDOMINAL HYGROMA THROUGH A SCALPEL PRICK OF THE PERITONAEUM[1]

On May 19, 1893, a child two years old was brought from the Out-Patient Department of The Johns Hopkins Hospital to the operating room with the request that she be tapped for ascites. On two or three occasions fluid had been withdrawn by the dispensary physicians from the distended abdomen, but on this morning repeated attempts to relieve the distension with the trochar and cannula had been unsuccessful, hardly a drop of fluid being obtained. The child's abdomen presented, as it seemed to us, the typical ascitic picture.

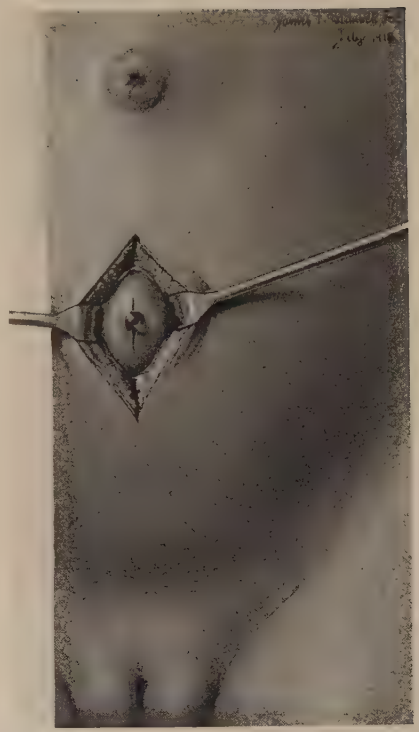
In making a short incision in the midline I accidentally pricked the peritonaeum. Immediately there protruded through the prickhole a vesicle hardly larger than a mustard-seed. The little bladder, slowly increasing in size (Plate CII, 1 and 2), soon covered the abdomen, and finally in saddle-bag fashion fell over the child's flanks, a broad, flat isthmus of sac-contained fluid stretching across the now scaphoid belly from one great bag of water to the other, both of these resting on the bed-sheets (Plate CIII). The wall of this great cyst was of filmy thinness.

The midline incision was then lengthened and a search made for the pedicle about which several small cysts were found to be grouped. All of these seemed to have their origin in the great omentum—embryologically, in the posterior mesogastrium. An independent cyst, about as large as an orange, seemed to be contained between the layers of the duodenal mesentery, the continuation of the stomach's mesentery or posterior mesogastrium. This cyst was so adherent to the mesenteric vessels that we feared its removal might imperil the circulation of the bowel; hence we stitched its wall to the parietal peritonaeum, and in a few days opened and drained it. The child made a prompt recovery.[2]

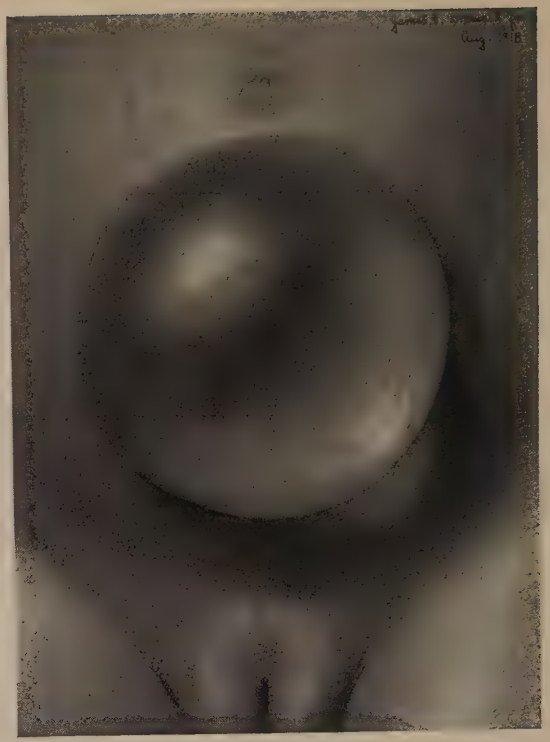
Twenty-two years later, in 1915, after prolonged search, this patient was finally traced and persuaded to come to the hospital for examination. She was then 24 years of age, married and in good health. Her mother stated that she had suffered no ill effects from the operation. Examination of the abdomen revealed nothing abnormal except perhaps a little tenderness in the region of the appendix.

[1] Johns Hopkins Hosp. Bull., Balt., 1920, xxxi, 13-14. (Reprinted.)

[2] Full details of this case are recorded in the hospital history, Surg. No. 2245.



1.—Vesicle Projected Through a Prick-hole in the Peritonaeum.



2.—A Subsequent Stage of the Vesicle.

Its Ultimate Aspect.

I have found no record of a case of abdominal hygroma observed so many years after operation for its removal.

The surgeon should bear in mind the possibility of lymphatic cyst whenever a child with distended abdomen comes under observation.

In April, 1916, an infant, aged seven weeks, was operated upon in extremity at The Johns Hopkins Hospital[3] for the relief of what was supposed to be intestinal obstruction. The cause of the distension proved to be a lymphatic cyst, and the child promptly succumbed to the operation. It is conceivable that this infant might have been saved, had the correct diagnosis been made and the cyst evacuated or possibly eventrated through a small incision.

[3] Surg. No. 39451.

THE TRAINING OF THE SURGEON

AND

OTHER ADDRESSES

DR. TIFFANY'S PLACE IN AMERICAN SURGERY[1]

It is with great pleasure and eagerness that I embrace the privilege of this opportunity to express my high appreciation of Professor Tiffany's work as a surgeon and my admiration of the man.

Just a century and two years ago the Medical School of the University of Maryland was founded by William Gibson, one of the most distinguished names in American surgery, and I think it may truly be said that during this period no school in America has been more fortunate in the choice of men to direct the department of which Dr. Tiffany was for so long a time the head and the inspiration. All were surgeons of national reputation, and some of international renown; and the names of more than one of these will live always.

From 1812-1819 the chair was held by Wm. Gibson; from 1819-1820 by John B. Davidge; from 1820-1826 by Granville Sharp Patterson; from 1826-1827 again by Davidge; from 1827-1869 by Nathan R. Smith; from 1869-1880 by Christopher Johnston; from 1881-1902 (22 years) by Louis McLane Tiffany. Possibly there are present tonight several who knew personally all of these men, and to whom the story from the beginning, which seems far away to some, is still vivid.

Most of these surgeons have made important contributions either to their art or science. They have been men of unusual culture, of high ideals, of broad sympathies and were preeminent in position and influence.

It must be a stimulus and a source of great satisfaction to the worthy occupant of the chair today to contemplate the notable deeds and the illustrious names of his predecessors.

It is all very modern history and the names of the professors of surgery in the University of Maryland are still household words in the state, even in the families of those of us who came here by invitation and who, being received so cordially and adopted so unequivocally have now, after a quarter of a century, become Marylanders as true, even if not quite so blue, as the proudest of her sons.

Although the story of the lives of these men, recently so well told by Dr. Cordell, must be quite fresh in your minds, I may nevertheless remind you of the particular deed of William Gibson, which insures immortality

[1] Presented at a meeting of the Baltimore City Medical Society in honor of Dr. Louis McLane Tiffany, December 19, 1914.

Bull. Med. & Chir. Fac., Maryland, 1913-1914, vi, 131-133.

for his name and for his university. I refer to the ligation by him of the common iliac artery in 1812 when he was only 23 years of age; this operation was then performed for the first time, and it was undertaken for the control of haemorrhage.

Dr. John B. Davidge, Gibson's successor, was one of the very first to ligate the gluteal artery for aneurism.

To this, the most dramatic chapter of all surgery—to the treatment of aneurism—no country has contributed nearly so much as America, and with the exception of Valentine Mott's, these pioneer and courageous ventures in the ligation of the large arteries and the excision of large aneurisms have all been made by surgeons in the Southern States. The most important of the newer work in the treatment of aneurism has also been done by surgeons of the South.

Smythe of New Orleans was the first (1864) to tie the innominate successfully. He ligated the carotid, and then later the vertebral, and finally, after 10 years, in operating to cure the aneurism which had returned, lost his patient from haemorrhage during the operation.

It was in the South that the first part of the left subclavian was tied for the first time, that a subclavian aneurism was first excised, that the thoracic aorta and the arch of the aorta were first operated upon by opening the thorax.

From New Orleans we have Matas, who has given us the operation of endo-aneurismorrhaphy; and who, by the way, a few years ago performed successfully a superb operation under cocaine for the cure of an arteriovenous fistula between the subclavian artery and the vein.

Many of Dr. Tiffany's operations were performed before the practice of Listerism had become established in this country, and hence required a courage and resourcefulness which the younger surgeons of today can hardly comprehend.

I had been in Baltimore only two days—this was in 1886—when an invitation was received to a reception at Dr. Tiffany's home. In the succeeding years we were both so busily engaged in work at our respective schools that our paths seldom crossed, but on several occasions I accepted the cordial invitations which he gave me to attend his clinic at the University of Maryland, and although the operations which I happened to see were comparatively trivial ones, I became convinced that he was a master of his art, and that the students on the benches could hardly comprehend their good fortune in having a man of Dr. Tiffany's endowments as their teacher. A courageous, forceful, upright and highly talented surgeon, and withal a dignified and polished gentleman was the comment I made to myself on leaving the amphitheatre.

I have references to about 70 papers by Dr. Tiffany in the two decades from 1878 to 1898. These contributions cover almost the entire field of surgery of the period, and have been admirably considered by Dr. Warfield.

I confess it was a surprise to me to find in Baltimore a surgeon so fully abreast, I might say ahead, of his time, and so thoroughly equipped by natural gifts, by training and by study for his vocation.

At the meetings of the medical societies Dr. Tiffany's word was regarded as authoritative, and his opinion was eagerly awaited. I recall vividly his restrained and admirable retort on one occasion when, having reported certain cases of malignant lymphoma, he was informed by a medical brother that he wouldn't give a whit for a surgeon's diagnosis of Hodgkin's disease.

Dr. Warfield has expressed the view that Dr. Tiffany perhaps did not so much aspire to be conspicuously original as to "build constantly on solid foundations, looking for better things and putting to personal test the work of others."

Public spirited men, those who concern themselves deeply with the immediate welfare of their friends and fellows, who respond eagerly to every call for assistance and strive to perfect themselves for the work that the day may bring forth, have not the time for the prolonged concentration required for the framing and solving of new problems.

JOHN SHAW BILLINGS[1]

It is merely as a friend of Dr. Billings that I shall speak tonight at this little gathering, realizing that I can add nothing to what has already been said in praise of his character and marvelous achievements. Recollections of my first introduction to Dr. Billings in 1887 are still vivid, for I realized that I was under inspection at the intimate little dinner which Dr. Welch had arranged for the three. During this and the following year Dr. Billings would occasionally step into my room at the pathological laboratory to say an encouraging word or to discuss some of the problems connected with the surgical department of the hospital and university.

In the organization of the dispensary, with which I was entrusted, I frequently sought his valuable aid. It was at his suggestion that the card index was introduced in the dispensary, where its value was so convincingly demonstrated that subsequently it was adopted in the hospital; and he found for us a trained man who remained a year to assist in inaugurating the system, which was new for hospitals.

In this hospital so admirably planned by him, no special provision for surgery was made by Dr. Billings. He enjoyed emphasizing this intentioned omission and making the comment that inasmuch as no two surgeons would be likely to have the same views as to what the ideal operating room and its accessories should be, it would have been a hopeless task to attempt to satisfy the then unselected director of the surgical department.

I shall never forget his words or his looks as he said to me after I had been told of my appointment, "Now you have the ball at your feet, all you have to do is to kick it." I understood his friendly, almost fatherly smile to say, "I am not quite sure that I approve of you altogether, but you may count upon my support." Since then he gave me many proofs that I had not misinterpreted his kindly glance.

Soon after the opening of the hospital Dr. Billings became my patient within its walls. One day as I was removing a subcuticular stitch of silver from his wound he protested, saying that the pain was considerable and that hence the procedure could not be ideal. I replied that we were experimenting with a new form of suture and had not as yet determined the proper time for its removal. "Oh, very well," he said, "go ahead, I can stand a

[1] Brief remarks at a special meeting of The Johns Hopkins Hospital Historical Club, Baltimore, May 26, 1913, in memory of Dr. John Shaw Billings.
(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1914, xxv, 249.

little pain in a good cause." Once or twice he invited me to his home in Georgetown. I would join him at the Surgeon General's Library and find him stuffing his overcoat pockets with journals and clippings. These he would take home with him every night and index before going to bed. He explained that these were details in connection with the indexing of the catalogue that he felt should be attended to by himself, and added, "If others see that I give careful personal attention to these matters they will realize that it must be worth their while for them to do the same."

Since then when oppressed by the seeming magnitude of one of my little ant-hills of work I have recalled the advice of Dr. Billings: "Devote a small amount of time each day to it and the mountain will melt away with astonishing rapidity."

The last time I met Dr. Billings was a few months before his death. We were traveling from New York to Baltimore and dined together on the train. His mental vigor seemed undiminished and his interest as keen as of old in his plans for the future of the various institutions which were guided by his masterful and dominant hand.

Dr. Billings was too great a man to be fully appreciated in his time.

The monuments of work which he has left are records the value of which cannot be estimated by the many, possibly by none; and the debt which others owe him for stimulus and suggestion can never be summed up.

THE TRAINING OF THE SURGEON [1]

Pain, haemorrhage, infection, the three great evils which had always embittered the practice of surgery and checked its progress, were, in a moment, in a quarter of a century (1846-1873) robbed of their terrors.[2] A new era had dawned; and in the 30 years which have elapsed since the graduation of the class of 1874 from Yale, probably more has been accomplished to place surgery on a truly scientific basis than in all the centuries which had preceded this wondrous period. The *macula levis notae* clung to surgeons the world over until the beginning of the nineteenth century, although distinguished and scholarly men, as well as charlatans and barbers, have practised the art in almost unbroken succession from the time of Hippocrates (460-375 B. C.) to the present day. A warning for all time against satisfaction with present achievement and blindness to the possibilities of future development is the imperishable prophecy of the famous French surgeon, Baron Boyer, who over a hundred years ago declared that surgery had then reached almost, if not actually, the highest degree of perfection of which it was capable.[3]

[1] The Annual Address in Medicine, delivered at Yale University, New Haven, Conn., June 27, 1904.

Johns Hopkins Hosp. Bull., Balt., 1904, xv, 267-275. (Reprinted.)

Also: Am. Med., Phila., 1904, viii, 69-75.

[2] Verhandlungen der deutschen Ges. f. Chirurgie, 1896, von Esmarch.

[3] Could Boyer, we ask, have been satisfied with the status of surgery when anaesthesia was undiscovered, when haemorrhage was awkwardly and insufficiently controlled, when infection of wounds was not understood and could not be prevented? And yet I might quote from the writings of distinguished men of our time to show that even today some think that surgery is almost complete. Anaesthesia, one of the greatest blessings, is at the same time one of our greatest reproaches, haemorrhage is still awkwardly checked, and of surgical infection once started we have often little control and then mainly by means of the knife. We have reason to hope that the day will come when haemorrhage will be controlled by a quicker procedure than the awkward, time-consuming ligature; when infections will be controlled by specific products of the laboratory; and when pain will be prevented by a drug which will have an affinity only for the definite sensory cells which it is desirable it should affect. The first of these may be last and the last first. Let us trust that it may, as Gross expresses it, "be a long time before the laws of this department of the healing art will be as immutable as those of the Medes and Persians."

"Literature," said Horace Walpole, "has many revolutions; if an author could rise from the dead after a hundred years what would be his surprise at the adventures

Tempted to belittle by comparisons the performances of our progenitors, we should remember that the condition of surgery has at all times reflected the knowledge and thought of the ablest minds in the profession. We may well recall the admonition so gently given by the highly talented von Volkmann, who was also a popular poet, writing under the pseudonym of Richard Leander.

> "Hoch aufhebt Schnee-schimmernd das Haupt in die Wolken
> die Jungfrau,
> Aber sie deckt mit dem Fuss ein unendliches Land."

Surgery, like other branches of the healing art, has followed in its progress zigzag paths, often difficult to trace. Now it has seemed to advance by orderly steps or through the influence of some master mind even by bounds; again it has stumbled apparently only from error to error, or has even receded; often there has appeared some invention or discovery for which the time was not ripe and which had to await for its fruitful application or perhaps its rediscovery a more favorable period, it might be centuries later.

There is a most intimate interdependence of physiology, pathology and surgery. Without progress in physiology and pathology, surgery could advance but little, and surgery has paid this debt by contributing much to the knowledge of the pathologist and physiologist, never more than at the present time. Harvey's immortal discovery marks an epoch for surgery, as it does for all medicine, for without knowledge of the circulation of the blood only the most primitive kind of surgery is thinkable. And yet there is abundant proof that the ligation of vessels, with the introduction of which Ambrose Paré (1517-90) has until recently been accredited, was known to the school of Alexandria; carried, it is said, to Rome by Euelpistus, it is mentioned by nearly all surgical writers of importance, from Celsus to the Renaissance. The brilliant Fallopius (1523-62), Paré's contemporary, alas a very short-lived one, wrote much about the use of the ligature for the arrest of haemorrhage. Nevertheless, until Harvey demonstrated (1628) the true course of the blood, the principles underlying the control of bleeding by the ligature could not be understood, and surgeons studiously avoided operations which entailed haemorrhage and necessitated its control.

We can hardly understand in these days that surgeons who were at the same time anatomists and physiologists could have accepted for so many centuries, almost without remonstrance, Galen's views. Our inability to

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of his work." Gross recognized, not altogether without regret, that this was particularly true of scientific works however erudite they may be. "Few survive their authors."[4]

[4] Gross: Autobiography, vol. i, p. 140.

comprehend their state of mind with reference to this problem illustrates particularly well the difficulty experienced when we attempt to transport ourselves to other times, to obtain the point of view which subjugated our forefathers of centuries ago. It is now, as it was then and as it may ever be; conceptions from the past blind us to facts which almost slap us in the face. The blood which spurted from the divided artery was believed to come not from the left heart, but in some mysterious and indirect way from the veins, in which it was supposed to flow and ebb to and from the right heart. Harvey knew nothing of the paths by which the arterial and venous systems communicate, and his discovery was not made complete until Malpighi in 1661 demonstrated by the microscope the capillaries.

How bewildering haemorrhage must have been when a wound suddenly filled with blood from a source unknown, and when sometimes, with little bleeding, a patient suddenly died from aspiration of air into the veins! What more natural than to pack quickly the wound, as Heliodorus and others were wont to do, with compresses of lint or sponge, to ligate large masses of tissue by circumvection, to draw the bleeding edges of a wound tightly together by stitches, as is still sometimes done, or to sear the bleeding surfaces with the cautery or with boiling oil! Imagine the terror and suffering of the patient, the desperation and haste of the surgeon, conditions not suited to the tranquil pursuit of physiological knowledge.

In all times, even to the present day, the surgeon's chief concern during an operation has been the management of the blood vessels. The fear of death on the table from haemorrhage has deterred many a charlatan and incompetent surgeon from performing otherwise perilous operations. The care exercised in the control of haemorrhage may constitute the chief difference between a rapid and a slow operator. This was eminently the case in the days within my experience when two or three artery clamps were considered abundant for operations which now require one or even two hundred.

The five things declared by Paré, usually designated as the father of French surgery, as proper to the duty of a surgeon may serve to indicate how restricted was the field of surgery before the course travelled by the blood was determined:

1. To take away that which is superfluous, as in amputations.
2. To restore to their places such things as are displaced, as in hernias.
3. To separate those things which are joined together, as in parts rendered adherent by burns.
4. To join parts which are separated, as in stitching up a wound.
5. To supply the defects of nature, as in setting an eye, an ear, a nose, or one or more teeth; filling up the hollowness of a defective palate with a gold or silver plate.

The studies of Hunter, born just 100 years after Harvey published (1628) his demonstration of the circulation of the blood, and about 70 years after Malpighi discovered the capillaries, on the healing of wounds, on inflammation, on the ligation of arteries, were made possible by the discoveries of these great investigators. John Hunter's (1728-1793) name is eclipsed by that of no other surgeon, and for the fame of his contributions, particularly to biology and physiology, an inextinguishable lamp will forever burn. Let us remain with him, if only for a moment, for he is an inspiration and a teacher for us all, as great perhaps for his time as the world has seen or will ever see again.

How fascinating to follow the groping in the dark and the searching for the light of a great mind! How refreshing and what a lesson is his honest doubt! "I am not able under such circumstances," he writes,[5] "decidedly to say which is the best practice, whether to leave the slough to separate, or to make a small opening and allow the blood to escape slowly from the cavity." And again, speaking of that common class of injuries in which the wound communicates externally and the blood has formed a scab over the breach, he says:[6] "But this operation of nature reduces the injury to the state of a mere superficial wound, and the blood which is continued from the scab to the more deeply seated parts, *retaining its living principle* [italics mine], just as the natural parts do at the bottom of a superficial wound, the skin is formed under the scab in the one case as in the other; yet if the scab should either irritate or a part underneath lose its uniting powers, then inflammation and even sometimes suppuration may be produced." Here Hunter recognizes facts which have been fully appreciated only in recent years, that there is a power for good in the blood, that the blood clot has a value and should be undisturbed, and that the dry scab usually desirable is sometimes harmful.

Under the conditions existing until the time of Hunter near the end of the eighteenth century, it was doubtless right that the practising surgeon should have been sharply differentiated in social position and professional standing from the physician proper, the latter being equipped with all the academic knowledge of the time, the former an apprentice of the barber shops. "The reasoning of the army surgeons endured as butter in the sun," wrote Abraham a Gehema in 1690, and the army commanded the services of the best surgeons. Nevertheless, it is often refreshing to find records of sound personal observations in the writings of the old surgeons, who, rude and unlettered though they might be, were dealing with realities at a time when the minds of physicians were buried in scholastic subtleties and fruit-

[5] Hunter: Palmer's ed., vol. iii, p. 247.
[6] *Op. cit.*, p. 252.

less speculations. In the German universities, when chairs of surgery were first created, it was considered beneath the dignity of the physician who taught the doctrines of this art actually to practise it. Thus Haller (1708-77) about the middle of the eighteenth century taught, among other things, surgery both in Goettingen and Berne, but never demeaned himself to perform an operation. Billroth,[7] commenting on this arrangement, says: "That Albrecht von Haller in Berne should for many years have lectured on surgery without ever having touched a single human creature with the knife is for us, in these days, hard to comprehend." How different apparently from Haller's was the attitude of mind at that time of John Hunter (1728-93) in England, whose practice yielded a yearly income of 6000 guineas; and yet in spirit perhaps not so different after all, as exemplified by the remark to an assistant, "Well, Lynn, I must go and earn this damn guinea, or I shall be sure to want it tomorrow."

Even in America a little more than a hundred years ago a definite stigma still adhered to the exercise of the surgeon's art. Thus writes the eminent Dr. John Morgan, founder of the Medical Department of the College of Philadelphia, later the University of Pennsylvania, in a letter from London, November 10, 1764, to Dr. Cullen, after a long period of study abroad: "I am now preparing for America to see whether, after 14 years of devotion to medicine, I can get my living without turning apothecary or practitioner of surgery."[8]

It was not until the year 1800 that the Royal College of Surgeons received its charter, and then only with great difficulty. Parliament had again and again refused to grant a new charter to the disbanded "Company of Surgeons." Lord Thurlow is reported to have said in the House of Lords when the bill had passed the Commons: "There is no more science in surgery than in butchering," and it was only when the Court of Examiners, a body still in existence, decided to appeal to the Crown, to King George III, that the charter was ultimately obtained. From the days of the great Hohenstaufen, Frederick II, who in 1231 commanded the teachers at Salernum diligently to cultivate the art of dissection, up to the present time medicine has repeatedly been aided and advanced by the enlightened intervention of kings and rulers. When Maria Theresa brought Gerhard van Swieten from Leyden to Vienna in the face of great opposition from the profession, she laid the foundations of the fame of the medical school of Vienna and she placed to her credit an achievement from which Austria and Germany still profit. In Prussia medicine has enjoyed the support of the Crown without interruption from the time of Frederick I to the present day. The splendid new

[7] Lehren u. Lernen, p. 45. Wien, 1876.

[8] Packard: The History of Medicine in the United States, p. 191.

equipment of the surgical department of the University of Berlin is largely the result of Emperor William II's wisdom and liberality. "A king or a privileged class," writes President Hadley,[9] "ruling in accordance with traditions and trying to act for the interests of the people, will give a much larger measure of real freedom than is possible under a democracy whose members have no respect for the past and no higher aim than their own selfish advancement."

The founding of the Academy of Surgery in Paris, in 1731, has been referred to as the turning stake in the history of surgery, as the starting line of its scientific labors and of its true career, and the French regard the five anatomical demonstrations made a few years before by the surgeon La Peyronie in the College of St. Côme as the inauguration of the new epoch. Von Bergmann reminds us that a Theatrum Anatomicum for students of surgery was erected in Berlin in 1713, but this exerted no such wide influence as the Paris Academy. The development of clinical teaching can be traced by unbroken tradition directly to Boerhaave, professor at the University of Leyden in the early part of the eighteenth century, and a teacher of unsurpassed influence and renown. His pupils carried the new methods to Austria, to Germany, to Edinburgh, and their descendants in the faith were the founders of the early medical schools in this country. In its influence upon the development of medical teaching the University of Leyden occupies historically the first position.

The relation of surgery to general medicine at the end of the eighteenth century was in Germany much less satisfactory than in Great Britain and in France. Under the teacher of clinical medicine was a surgeon who demonstrated the surgical cases. When Reil was called from Halle to Berlin in 1810 as professor of medicine, he naturally expected that the customary relations would be preserved and that Carl Ferdinand Graefe, a young protégé of Wilhelm v. Humboldt, would operate under his direction. But by a mandate from the throne the independence of Graefe and of surgery was established. Graefe was given a responsible post as army surgeon, and his services in war were of such a high order and so greatly esteemed by the King that an independent surgical clinic was soon established and entrusted to him. The first equipment of this clinic was a very modest one, conforming to the straightened condition of the state's exchequer. Five times in the first nine years of its existence his hospital of 10 beds was obliged to seek new quarters, but in 1818 it was located at the site of the present surgical clinic of the University of Berlin. Philipp v. Walther, his illustrious contemporary, gives his impressions of Graefe's clinic, which he visited in

[9] Arthur T. Hadley: The Relations between Freedom and Responsibility in the Evolution of Democratic Government. Chas. Scribner's Sons, 1903.

1834: "A remarkable, splendid spectacle, conducted in a dauntless and highly gifted manner is Graefe's clinic in Berlin; we have no prototype of it either in France, England, North Italy or Holland. Its disposition is entirely national, purely German." "What changes have taken place in a single generation," writes von Bergmann,[10] "changes brought about by the same indefatigable activity of the German clinical teachers and by their absolute devotion to their work, the devotion springing from innermost convictions which made it possible for Graefe after 15 years of clinical toil to win such testimonials from his fellows."

In the year 1876, the year when I first walked the wards of Bellevue Hospital, New York, the dawn of modern surgery in America had hardly begun, and it may be of interest to note some of its characteristics at that time. The discovery of ether was not so old as to have obliterated all traces of the old surgical rule, "Cito, tuto, jucunde," but the rapid method of operating was gradually giving place to the safer one. Conservative surgery was made possible by general anaesthesia, as was illustrated particularly well in the exsection of joints and the subperiosteal resection of bone. The discovery of the ophthalmoscope, an invention of incalculable importance, had led to the establishment of the specialized eye surgeon, and it soon proved a great boon to general surgery, leading as it did to the adoption of innumerable specula and mirrors for the examination of hitherto unexplored regions. As a result of a reaction against bleeding and against the reckless waste of blood at operations, there developed a fondness, almost a mania, for bloodless operations, for styptics and the actual cautery, for écrasement linéaire (Chassaignac), for galvano-puncture and electrolysis. To the employment of galvano-puncture in the treatment of arterial angiomata is due the introduction by Pravaz of the hypodermic syringe, which it is interesting to note was originally designed solely for the purpose of conveying to these growths a substance (solution of chloride of iron) capable of producing coagulation. This little instrument, destined soon to play a part so useful, so indispensable, entitles its inventor to the lasting gratitude of mankind.

None of these methods for the bloodless division of tissues was destined to supplant the knife, so that surgeons became interested in devising better means for the prevention of loss of blood. In 1873, at the German Congress of Surgeons, in Berlin, von Esmarch gave to the world his method of producing artificial bloodlessness ("die künstliche Blutlehre").[11]

[10] Die Entwickelung des chirurgischen Unterrichts in Preussen. Berlin, 1893.

[11] Verhandlungen der deutschen Ges. f. Chirurgie, 1896. (The Jubilee Congress.)

Von Esmarch is one of the very few surgeons living who, even as a student, can recall the days before anaesthesia. He maintains that he who was not a participant

But no truly great and essential progress in fundamental surgical principles had been made since Hunter's time, until the monumental labors of Pasteur opened the vista through which for a time only the eyes of Lister could peer. It is hard to realize that 40 years have passed since Lister and Pasteur made to surgery a contribution rivalled only by Harvey's in impor-

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of those times cannot picture to himself the enthusiasm which took possession of every physician, and particularly of the students in the surgical clinic. Whereas before the introduction of ether, the operating rooms were filled with the groans and shrieks of the unfortunate victims, the appalling spectacle causing many students to faint, now, of a sudden, absolute quiet reigns, a stillness almost supernatural, broken occasionally by the senseless chattering or joyous singing of the patient.

Familiarity with the use of cocaine in surgery has robbed somewhat the preanaesthesia days of their interest to the surgeon. We used to admire and wonder at the courage of the old-day surgeons who could inflict such torture for such small rewards, but we know now that certain operations can be performed with very little pain even without the employment of a local anaesthetic. It is often unnecessary to do more than anaesthetize the skin to perform a very considerable operation, in the neck for example. From cocaine we learned in one year (1885) more about the relative sensitiveness of the various tissues and organs than from all the literature of our forefathers. The skin being anaesthetized and incised, we were surprised to find that the underlying parts were comparatively insensitive to handling and for the most part, even to cutting. The accidental cutting or crushing of nerves caused the most exquisite pain, and we noticed that the nerve supply of the blood vessels[12] is so abundant that the severing or clasping of even very small bleeding points usually startled a cry of some sort of remonstrance from the patient; and now after many years of experience with cocaine we interpret an unexpected moan as signifying an insult to some small unseen blood vessel or nerve. These facts learned, I say, in one year, perhaps in six months of experimentation with cocaine, were not clearly revealed by all the previous ages of surgery. The explanation undoubtedly lies in the facts that in olden times the first cut through the skin so unnerved the patient and perhaps the surgeon that differentiation was impossible, and that the operation was performed in such haste as to preclude careful observation. I fear that so much practice with cocaine as an anaesthetic has obtunded to some extent our sensitiveness to pain in others. Formerly it taxed one severely to employ cocaine in certain operations which we now perform with equanimity; we are in danger perhaps of acquiring the kind of immunity (it is not indifference) which it seems to me dentists possess or have cultivated to such a high degree. Briefly, then, the story of the surgery of preanaesthesia days has become less interesting because it has been robbed of its terrors by the lessons which cocaine has taught us. If the surgeon of the past could only have known what it seems to the modern surgeon he should have known better than all else, namely, the relative sensitiveness of the various tissues, he could hardly have failed to discover methods of producing anaesthesia of the skin. That one could deliberately divide a nerve of the size of the sciatic or ulnar or even the minutest filaments visible without exhausting his ingenuity to find something to deaden the exquisite or agonizing pain seems inconceivable. How blind we are and how blind we ever shall be.

[12] John Hunter recognized the fact that parts richly supplied with blood were much more sensitive than the comparatively bloodless parts.

tance. It was in 1867 that Lister first made known the almost incredible results of his experiments with carbolic acid in the treatment of wounds. The great merit of Lister lies in his clear recognition of the significance of Pasteur's discoveries in revealing the underlying causes of the infection of wounds and in the adoption of measures fitted to prevent and combat such infection. This merit will remain whatever changes may be made in the details of antiseptic and aseptic surgical procedures.

It was not, however, until 1875 that even in Germany Listerism obtained a substantial foothold. How I should like to tell the true story of this period in this country and abroad, to do full justice to Lister and his few faithful disciples in the United States and Great Britain, who for nearly 20 years contended with prejudice and parried the almost venomous thrusts of the skeptical and the envious.

Why was Germany the country first to adopt antiseptic surgery? Why did almost every surgeon in every German university eagerly embrace Lister's system almost at the same moment and as soon as it was clearly presented? The answers to these questions are, I believe, to be sought mainly in the character of the scientific and practical training of surgeons in Germany, and it is especially upon the question of the training of surgeons that I wish to dwell in the remainder of this address. What I shall have to say relates not so much to the mere teaching of surgery in the undergraduate curriculum, as to the requirements for the training of those who desire to fit themselves for a career in surgery.

Thirty years ago as I sat upon the benches, often seven hours a day, listening to medical lectures, I was so impressed with the characters and lives of some of my teachers that I believed they represented all that was most advanced in medicine. But a day in Halle, at the clinic of Volkmann, was a revelation to me. There I heard by one of the young assistants at the early morning clinic an impromptu discourse on epithelioma at which I marvelled. At home the whole subject of tumors had ben treated of in one lecture, in one hour, in the "tumor lecture." Attending the Congress of German surgeons, which each year takes place at Eastertide in Berlin, I heard the subject of hip joint tuberculosis discussed. One surgeon alone reported on 600 cases, more or less, some of which he had observed 20 years or longer and most of which he had been able to follow. His methods of observation were new to me; his knowledge was inspiring; I was thrilled by his masterful exposition. Within two weeks, by a strange coincidence, I found myself attending in America a meeting of a very superior "surgical society" in one of our large cities, at which the same subject, "morbus coxarius," was under consideration. Only one of the surgeons had had an experience of as many as 28 cases, and of the subsequent history of most

of these he knew very little. The contrast was not only in the knowledge and presentation of and interest in the subject, but in the audience. The Deutsche Gesellschaft für Chirurgie admits to its fellowship any reputable surgeon of any country of the world, and its halls at each Congress are filled and overflowing. The membership of the select "surgical society" was limited to 20 and the average attendance was less than this number.

It may be that the rise and multiplication of proprietary schools of medicine without organic connection with a university was a necessary incident in the rapid growth of a new country, but it is absurd to expect them to yield results in the education of physicians and in the advancement of knowledge comparable with those of the well-supported medical departments of European universities. It is difficult to free either the educated public or our universities from the reproach that they remained so long indifferent to the needs of higher medical education. The times are changing, and we have learned in our own time, indeed within a decade, how superior in all respects is the endowed university medical school to the old-time proprietary school. Who would have believed that one or two well-utilized endowments could have achieved in so short a time so much? It was not only because some of the best men in this country were attracted to the university medical schools, fortunate enough to be so endowed, that the great progress was made; it was also because the further development of these men was made possible by the opportunities which they proffered and the atmosphere which they developed. The influence of these men, comparatively little before, almost at once, under the new auspices, was felt, not only in this country, but abroad. The growth of these men and of these schools has been so great that they are already well known and honored in all civilized countries. Much of what Welch foretold here in 1888 and in Cleveland in 1894 [13] has already come to pass.

Although we now have in the United States several (five or six) moderately well-endowed medical schools with a university connection, the problem of the education of our surgeons is still unsolved. Our present methods do not by any means suffice for their training. Do we require stronger proof of the inadequacy of these methods in producing young surgeons than is presented by the so-called sacrifices which our young men today are willing, nay, most eager, to make in order to obtain a training which seems even to them not only desirable but absolutely essential for success of a high order? Here I may be permitted to instance conditions which have evolved

[13] W. H. Welch: Some of the Advantages of the Union of Medical School and University. New Englander and Yale Review, Sept., 1888.

Higher Medical Education and the Need of its Endowment. Medical News, July 21, 1894.

in a natural way at The Johns Hopkins Hospital, where the plan of organization of the staff differs from that which obtains elsewhere in this country.[14] The average term of service for the interne on the surgical side who succeeds to the house surgeonship in this hospital is at present eight years—six years as assistant, in preparation for the position, and two years of service as actual house surgeon. Adding to these the four years in the medical school and the junior and senior years in college, which in some colleges may well in considerable part be devoted to branches introductory to the study of medicine, the prospective house surgeon has to contemplate 12 or 14 years of hard work, very hard work, in order to secure this prize to which in this country of necessity only a very few at present attain. Thus far the success of the three or four men who have received, approximately, this training is so convincing that the very best graduates of our own and other schools are eager for the opportunity to be tested as to their fitness to rise to the position; and I know from applications which have been made to me this year that men of the desired quality would gladly serve 10 years on the surgical staff in order to obtain the experience which the house surgeonship and the training leading to it affords. The number of years which an interne

[14] The surgical staff consists of nine men, eight internes and one externe. The externe is an assistant in surgical pathology, he attends operations whenever it seems desirable in order to do with a clearer understanding the pathological work, to take charge of and describe[15] the pathological material obtained at operations and to keep in touch, for his own benefit, as well as for the sake of the surgical department, with the clinical work. Four of the internes serve for one year, only the honor men of each class at graduation being entitled to these positions; but the *permanent staff*, so-called, consists of four men, the house surgeon and three in line of preferment. Men from any part of the country, if they have had the proper training, are eligible for the permanent positions. Great care is exercised in the filling of the vacancy on the permanent staff, which occurs once in two or three years, and advancement is not guaranteed to the appointee. The House Surgeon's term of service is still opitional. He receives a salary; the other assistants are not paid. The assistants are expected in addition to their ward and operating room duties, to prosecute original investigations and to keep in close touch with the work in surgical pathology, bacteriology and, so far as possible, physiology.

[15] I am sure that much of the material for surgical patholgy can be correctly described only when it is perfectly fresh. It cannot be painted because in less than a minute, in a few seconds often, the appearance of a freshly cut surface is greatly changed. Only those who are well trained as macroscopic pathologists, who have naturally a discriminating eye for color, a good sense for form and some talent for expression can properly describe the fresh material. Many, if not most, of the descriptions are worthless or at best serve only as reminders to those who can distinctly recall the case. The descriptions, by two trained men, of ordinary fresh material may differ so greatly that one could not believe they pertained to the same specimen. Color photography might be employed, it seems to me, with great benefit, for recording the appearance of fresh specimens.

who has become house surgeon is expected to serve with us is not and never has been prescribed.

It will be objected that this is too long an apprenticeship, that the young surgeon will be stale, his enthusiasm gone before he has completed his arduous term of service. These positions are not for those who so soon weary of the study of their profession, and it is a fact that the zeal and industry of these young assistants seem to increase as they advance in years and as their knowledge and responsibilities become greater. Nowhere certainly can a surgeon in a given period acquire so much, mature so rapidly, as in a hospital with an active and properly-conducted service. The time devoted to the training in surgery of those who hope to be teachers should not be curtailed, but young men contemplating the study of surgery should as early in life as possible seek to acquire knowledge of the subjects fundamental to the study of their profession.

It was our intention originally to adopt as closely as feasible the German plan, which, in the main, is the same for all the principal clinics of the German universities. The house surgeon, or first assistant, as he is called in Germany, is selected, after several years of service, from a number of well-tried assistants. There is no regular advancement from the bottom to the top of the staff of resident assistants. Only a small proportion of these venture to entertain the hope of becoming first assistant. Occasionally an assistant from another clinic may immediately, or almost at once after transfer, succeed to this position over the heads of those who have served many years. This admirable system, which undoubtedly has its disadvantages, is possible only in a country where like conditions prevail and a close affiliation exists between the universities or where some great inducement exists for the making of assistants of the highest possible order. The professor of surgery, or the surgical chief, desires to secure as his first assistant or chief of staff a man of great promise, not only because of the obvious immediate advantage to the clinic, but because such an assistant is likely to have tendered him, ultimately, the chair of surgery in some smaller university. It is a matter of great satisfaction and pride to a professor of surgery to have supplied from his staff one or more university chairs. So, too, it is a great disappointment and sometimes a keen sorrow to the professor of surgery when his scholarly, highly-trained and devoted first assistant after a service with him of eight or nine years is compelled to resign himself to an instructorship, to content himself with the title "Privat-Docent." This occurs often, in fact is usually the case, because there are so many more retiring first assistants than there are vacant chairs of surgery in the 20 German Universities. Whenever, consequently, there occurs by the death or voluntary retirement of a professor of surgery, a

vacancy in a university, there are possibly 20 first assistants and perhaps as many Privat-Docents hoping for promotion, not necessarily to this particular university, for the vacancy, unless it is in one of the smallest universities, is usually filled by the professor in a still smaller one.

What are the inducements which make it worth while for the young men in Germany to devote so many years to preparation for the practice of surgery, what the careers to which they aspire, and what manner of men are they who furnish by their example and by their achievements the great stimulus?

Not only the first assistants but all the members of the surgical staff of one of the great university clinics in Germany enjoy almost ideal facilities for learning surgery and for prosecuting researches. The amount of clinical material is great. The operative work begins early in the morning and often does not cease till late in the afternoon. The out-patient department is controlled by the chief surgeon and is conducted by his assistants; a patient when discharged is consequently not referred to some dispensary or other and lost sight of. The pathological material obtained at operation is carefully worked up in the special laboratories for surgery and, if need be, is preserved in the museum, which should always be an important feature of the surgical department of a university. Every facility and the greatest encouragement is given each member of the staff to do work of research.

Although during the eight to twelve years of hospital service as assistant in some large university clinic he has laid the foundation of his reputation, the real life work of a German surgeon begins when he is invited to fill a professorial chair. He now longs to prove himself worthy of the new position, he has the incentive to inspire others to achieve, he measures himself by a new standard, and there is born in him the desire to rise higher, to sow the seed which will produce a bloom worthy of the greatest universities, possibly even of Berlin. In European countries no effort, no amount of time, few sacrifices would be considered too great if thereby the chair of surgery in a university might be secured. In Germany the prestige of the position is something that we in the United States who have not lived abroad cannot truly comprehend. In each university the chair has its imperishable traditions, its long line of famous surgeons, whose names are cherished and revered for their services to science, to their universities, to their country and to their fellows. In the nineteenth century, to mention only some of those who have passed to the majority, in the University of Berlin, were v. Graefe, Dieffenbach, v. Langenbeck; in Vienna, Vincenz v. Kern, Billroth, Albert; in Heidelberg, v. Chelius, Carl Otto Weber,[16] Gustav Simon; in my

[16] Weber: It is interesting to note that Weber, professor of pathological anatomy at Bonn, at the instigation of Helmholtz, was called (1865) after long deliberation to

student days there were in Leipzig, Thiersch; in Halle, v. Volkmann; in Bonn, Busch; in Tübingen, Victor v. Bruns; in Munich, v. Nussbaum; in Strasbourg, Lücke; men of great renown, every one. To enroll one's name with such as these, to inherit something of their skill, their knowledge, their zeal, their honor, their sense of duty, is not this worth while? The professor of surgery in Germany is usually a man of great influence and power. His affiliations, his responsibilities, his knowledge of surgery and the allied sciences, and often of art, of music, of literature and of the world's affairs, produce a type of man which his country may well contemplate with pride.

America, too, in spite of discouraging circumstances, has produced great surgeons, but it is to be deplored that here conditions prevail which hitherto have not encouraged, if they have not actually prohibited, such special development as I have outlined. I have known professorial chairs in one of the principal medical schools of this country to go actually a-begging—a-begging, of course, only of men who would adorn the position. Recently I asked a prominent surgeon, to whom a chair in one of our chief universities had been offered, why he had not accepted it. He replied that his practice was a large and lucrative one and that he had neither the time nor the inclination to prepare and deliver 100 lectures, more or less, a year. Young men are naturally only too glad and eager to secure a professorship which would insure a good living and a certain distinction, but older men who are

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succeed Joseph von Chelius in Heidelberg. Much astonishment was naturally expressed that a pathologist should be invited to take a surgical chair, but the choice proved a most happy one, and although Weber lived to teach surgery only five semesters, he left in Heidelberg ineffaceable impressions of his great activity and learning.

In the days when operations the world over were few and far between, and when little was known of surgical pathology, it was natural and reasonable that particular stress should be laid upon a careful training in anatomy in preparation for the practice of surgery; but now when time is so short and the art of surgery so long and the operative material so abundant, the prospective surgeon's work in anatomy should be very much curtailed to give time for a very thorough training in pathology and also in physiology. The more definite the knowledge of a subject becomes, the more easily it is acquired. The surgeon should quickly master the anatomy which he requires, and gross pathology will soon be for him an easily explored field; he already looks to physiology for his particular field of research. The value to the surgeon of patient dissection of many injected and hardened cadavers is very much overestimated. The general topography of a part can be quickly and sufficiently recalled by reference to an illustration; it is a knowledge of the fasciae that the surgeon who wishes to perform an operation deftly and neatly requires, and this can be acquired only by rapid dissection of perfectly fresh material, or better still, of course, by frequent repetition of the particular operation. A hundred dissections of the embalmed neck would not shed much light upon the operations for the removal of goitre nor even of the ganglia of the sympathetic. I am speaking from the standpoint not of the student, but of him who wishes to operate artistically.

already well known and with an assured income have no inclination to undertake teaching of a prescribed kind for which they are not trained and for which the rewards are not in their opinion proportionate to the labor. Even to those who have held the chairs of surgery for years the work sometimes becomes so irksome that they seek to abandon it as soon as directly or indirectly it ceases to yield a sufficient return.

The faults of our system of educating surgeons begin almost at the bottom and continue to the very top. I am considering only the training of the best men, those who aspire to the higher career in surgery. On graduation they become hospital internes, but their term in the hospital is only one and a half, occasionally two years, only a little longer than the term of hospital service required in Germany of every applicant for the medical degree and not so long, on the average, as that required of each medical graduate of the University of Tokio. The interne suffers not only from inexperience, but also from over-experience. He has in his short term of service responsibilities which are too great for him; he becomes accustomed to act without preparation, and he acquires a confidence in himself and a self-complacency which may be useful in time of emergency, but which tend to blind him to his inadequacy and to warp his career. A surgeon should find his greatest stimulus and support in his assistants with whom he spends or should spend many hours a day; but this is only possible when they have had opportunities for sufficient development.

Think of the labor of breaking in two new house surgeons each year and of the incompleteness of their work. "I thought I had instructed you to examine the vocal chords after every goitre operation," complains the attending surgeon; "No, it must have been my predecessor or some other house surgeon whom you so enjoined," replies the interne. It is a grave mistake, it is a shame to check suddenly the advance of these superior young men who are tense with enthusiasm, who rejoice in the work to which they hope to be able to dedicate their lives. It is from these men, we must not forget, that our teachers of surgery are made.

But much as the interne suffers from the brevity of his hospital experience, the hospital suffers more and the surgeon most. Every important hospital should have on its resident staff of surgeons at least one who is well able to deal not only with any emergency that may arise and to perform any operation known to surgery, but also to recognize the gross appearances of all the ordinary pathological tissues and lesions.[17] But the interne leaves the hospital unequipped; eventually, it may be, he secures the position of attending surgeon to some hospital and then he is expected to teach others

[17] The internes should be encouraged and afforded every facility for the prosecution of work in research.

to perform operations which he himself has not learned to do, and to pronounce at the operating table upon conditions with which he is not familiar and which possibly he has never seen nor heard of.

We need a system, and we shall surely have it, which will produce not only surgeons but surgeons of the highest type, men who will stimulate the first youths of our country to study surgery and to devote their energies and their lives to raising the standard of surgical science. Reforms, the need of which must be apparent to every teacher of surgery in this country, must come on the side both of the hospital and of the university, and it is natural to look to our newer institutions, unhampered by traditions and provided with adequate endowment, for the inception of such reforms. It is eminently desirable, if not absolutely essential, that the medical school should control a hospital of its own. There should be such an organization of the hospital staff as I have indicated, providing the requisite opportunities for the prolonged and thorough training of those preparing for the higher careers in medicine and surgery, and permitting the establishment of close and mutually stimulating relations between chief and assistants.

The professors of medicine and surgery occupy a peculiar position. They are teachers in the universities and at the same time teachers in the technical schools, the hospitals, which in this country are in only one or two instances, unfortunately, under the control of the university. As university instructors it is still a question just how much of the technical they shall teach, and as workers in the technical school, the hospital and in private practice, how much time they shall devote to laboratory investigation. It is doubtful if an ideal adjustment, if there were such a thing, could always be preserved, because in one individual there reigns a passion for laboratory pursuits, in another the love of the practical and the rewards which practice may bring. Barker has recently, in his memorable address,[18] mooted this subject. Emphasizing the evils of the proprietary school and the inadequateness of what he designates as the "pseudo-university school," he proposes the name "semi-university school" for the "six or eight best medical schools in the United States," for the reason that only the subjects of the first two years are taught by men (university professors) "who do not engage in the private practice of medicine" and "who give their whole time and energies to the teaching and investigation of the sciences which they represent." It is to be noted that the true "university medical school," in the sense in which this designation is used by Barker, exists nowhere and probably never has existed.

[18] Medicine and the Universities: An address delivered before the Western Alumni of The Johns Hopkins University, at the meeting in Chicago, Feb., 1902. American Medicine, July 26, 1902.

The professors who teach in the departments of the last two years "are either not paid at all or are paid small sums, almost always less than the remuneration which pertains to a university chair, and almost always too little to provide the professor with a living income." "It is obvious," Barker continues, "that if those who teach the clinical subjects have to make their living from private practice, they will be compelled to direct their activities so as not to interfere with that practice." And further, he says, "I should like to see what the result would be if men with these capacities were bred to university careers, were placed in charge of hospitals especially constructed and endowed for university purposes and were sufficiently paid to permit them to give up private practice entirely and to devote their whole time and strength to teaching and investigating in such hospitals." Time permits only the very briefest consideration of this proposition, with which I am in the fullest sympathy, and which for a long time, perhaps for 20 years or more, I have seriously debated. Certain objections may nevertheless, I believe, with great propriety be urged against prohibiting the acceptance of fees by professors of surgery in universities.

1. To be an impressive teacher of surgery, to attract important cases in large numbers, to exert an influence far and wide as a surgeon, to know his subject thoroughly, the surgeon must operate every day and always. A very considerable part of the surgeon's time must be spent in the operating room; more and more, it would seem, as time advances, for the number and variety of operations which a general surgeon performs each year is prodigiously increasing.[19]

[19] Professor von Mikulicz writes me from Breslau "When I was a student in Vienna there were days, particularly in winter, when not a single operation occurred in the University clinic, so scarce was the operative material. Today the number of cases for operation is so great in the large German clinics that even when operations are conducted simultaneously on two tables we find that three or more hours of intense work is required almost every day." Through the kindness of friends in Boston and New York I am able to append the reports which testify to the great increase in the number of operations performed in a year in the Massachusetts General, the Boston City, the Roosevelt and the New York Hospitals. The statistics furnished by the venerable Massachusetts General Hospital are particularly instructive. In the entire decennium prior to the discovery of anaesthesia only 385 operations were performed in the hospital, an average of 38.5 operations a year. In the first decade subsequent to the employment of ether 1893 operations were performed, an average of 189 per year. In the decade preceding Lister's visit (1876) to this country, from 1868 to 1878, 7696 operations were performed. In the next decade only 10,119 operations were performed in this hospital; but from 1894 to 1904, 24,270 were performed; and in the year 1903, over three thousand operations were performed in the Massachusetts General Hospital.

The other hospitals mentioned show an increase in similar proportions. It may surprise some that the decade following the introduction of antiseptic surgery, from 1878 to 1888, should show such a slight increase. This may be taken as an indication of

Massachusetts General Hospital

Number of operations performed in decade previous to discovery of ether 385.
Number of operations performed in decade subsequent to discovery of ether 1893.
Number of operations performed in decade previous to use of antiseptics in this country (1878) 7696.
Number of operations performed in decade subsequent to use of antiseptics 10,119.
Number of operations performed during last ten years (1894-1904) 24,270.
Number of operations performed during year 1903 3109

Boston City Hospital

In 1878 316 operations were performed.
From 1878 to 1887, inclusive, 5882 operations were performed.
From 1893 to 1902, inclusive, 16,269 operations were performed
In 1902 1923 operations were performed

Roosevelt Hospital, New York

In 1878 132 operations were performed.
From 1878 to 1887, inclusive, 4060 operations were performed.
From 1894 to 1903, inclusive, 18,181 operations were performed.
In 1903 2719 operations were performed.
Operations in the Gynaecological division are included.

New York Hospital

In 1878 142 operations were performed.
From 1878 to 1887, inclusive, 2706 operations were performed.
From 1894 to 1903, inclusive, 13,002 operations were performed.
In 1903 1680 operations were performed.

2. With a fixed salary the surgeon may devote himself to the work of his choice, whatever that may be. If his tendencies are in the direction of research, he will neglect his operative work; if he is a natural operator, he will chafe under the restrictions which prohibit the acceptance of fees so easily within his reach.

I know of one or two men today occupying important chairs of surgery in Germany, to whom operating is less agreeable than teaching, and whose clinics, in consequence, suffer greatly from want of surgical material. Billroth had comparatively and actually little operating to do when in the days of sepsis he was most earnestly engaged in his microscopical studies and laboratory pursuits; and Thiersch, although one of the greatest names in surgery, was not a great operator and had small operative material even for his day.

3. An able and successful surgeon probably would not for the sake of fame merely and the usual professor's or any feasible salary be content to

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what is true, viz., that the majority of the operations which are done today were not only not attempted, but were not known fifteen years ago. Indeed many of them were unthinkable before the introduction of antiseptic surgery.

operate so constantly and to incur the anxieties attendant upon a large surgical practice. Indeed, he probably could not relinquish all fees if he would, for the exigencies of his family and his tastes would prohibit his doing so. Young and comparatively untried men could, of course, be induced to take the position, and some of these would undoubtedly regret the compact.

4. Barker proposes, if necessary, to give the professors of the practical branches (technical professors we may call them) a larger salary than the others; but this would at once place the purely scientific men in an awkward position; it would pave the way for discontent among the chemists and physicists and others, who might with propriety claim that their salaries should be increased because they, too, might make a fortune if they were allowed to turn their ideas or discoveries to commercial account. As a matter of fact professors of chemistry and physics accept fees, and all professors are at liberty to do so.

5. After all, the hospital, the operating room and the wards should be laboratories, laboratories of the highest order, and we know from experience that where this conception prevails not only is the cause of higher education and of medical science best served, but also the welfare of the patient is best promoted. It remains with the teachers of medicine and surgery to make them so. The surgeon and the physician should be equipped and should be expected to carry on work of research; they hold positions which should make them fertile in suggesting lines of investigation to their assistants and associates; they should not only be productive themselves, but should serve as a constant stimulus to others.

I should like to see the plan which Dr. Barker advocates carried out to the letter, and if it should succeed no one would rejoice more than I. But I would not advocate giving the surgeon or physician a larger salary than the others. The salaries of all must eventually be increased at least two or three-fold. There is, however, a compromise which even at present is altogether feasible. Let the surgeon be permitted to accept remuneration for services to certain patients operated upon in the hospital which the university provides or controls. His consultations and operations should all take place at the hospital. He might under only very exceptional circumstances be permitted to visit a patient in his town or state. Under special circumstances he might well be permitted to visit a patient in another state, if it were impossible for that patient to come to him. Private patients in a hospital need consume little or no more of the chief surgeon's time than the patients in the public wards.

While it has been my main purpose in this address to call attention to certain defects in the existing methods of medical education, especially in the opportunities for the advanced training of surgeons in this country,

I would not be understood to minimize or to decry the great achievements of American surgery. Courage, ingenuity, dexterity, resourcefulness are such prominent characteristics of our countrymen that it would have been surprising if from the labors of her many earnest and devoted teachers and practitioners there had not resulted contributions to the science and art of surgery which have carried the fame of American surgery throughout the civilized world. The names of your own Nathan Smith and Jonathan Knight will always be treasured not only by this university, but wherever the history of surgery is cultivated. There is barely time for even the briefest reference to the recent contributions of America's surgeons to their art and science, but I should do my countrymen scant justice did I fail to emphasize the importance of at least one monumental contribution, which, I believe, redounds more to the glory of American surgery than any achievement of the past. It is hardly possible to overestimate the value of the modern work on the subject of appendicitis nor to attribute to it too great a share in stimulating and clearing the way for the great strides made in the entire field of abdominal surgery in the past 12 or 14 years. It is convincing testimony to the advanced character of this epochal work that continental surgeons were for several years unable fully to comprehend and accept the teachings of their co-workers in the new country. As operators some of our surgeons are not surpassed by any I have seen; there are, I believe, few operations in surgery which cannot be performed as well in this country as anywhere in the world, and not a few operations are best performed by the surgeons of America.

A loyal son of Yale, I have rejoiced in the increasing prosperity of the Medical Department of Yale University during these recent years. Especially gratifying have been the manifestations of interest on the part of the University in the advancement of this Department and in general in the cause of higher medical education. I may be permitted to express my appreciation, and I believe I may add that of all concerned with these important problems, of President Hadley's valuable contributions to the discussion of this pressing topic.

It need hardly be said that the Yale Medical Department is hampered by inadequate resources. I am confident that during the past year no gift to the University has been more usefully and worthily bestowed than Mrs. Farnam's generous bequest to the Medical Department. With still larger additions to its endowment there is every reason to believe that the Yale Medical School will maintain a prominent position in the forward movement of medical education and research, and be one of the chief ornaments of this great university, receiving and conferring the stimulus of lofty ideals, of large achievements, of high renown

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Johns Hopkins Hosp. Bull., Balt., 1890, i, 111-112.
Also: Surgical papers (Halsted), Balt., 1924, i, 113.

32. Skin grafting. Exhibition of surgical cases at The Johns Hopkins Hospital Medical Society, Baltimore, October 20, 1890.
Johns Hopkins Hosp. Bull., Balt., 1890, i, 111-112.
Also: Surgical papers (Halsted), Balt., 1924, ii, 497.

33. Radical cure of hernia. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, October 20, 1890.
Johns Hopkins Hosp. Bull., Balt., 1890, i, 111-112.
Also: Surgical papers (Halsted), Balt., 1924, i, 263.

34. Tumor of undescended testicle. Reported at The Johns Hopkins Hospital Medical Society, Baltimore, November 3, 1890. (Appears only as a title.)
Johns Hopkins Hosp. Bull., Balt., 1890, i, 113.

1891

35. Intestinal anastomosis. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 1, 1890.
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 1-4. (Reprinted.)
    Also: (Abstr.) Centralbl. f. Chir., Leipz., 1891, xviii, 378.
    Also: Surgical papers (Halsted), Balt., 1924, i, 212-219.
36. The treatment of wounds with especial reference to the value of the blood clot in the management of dead spaces.
    Johns Hopkins Hosp. Rep., Balt., 1890-1891, ii, 255-314. (Reprinted.)
    Also: Maryland M. J., Balt., 1891, xxiv, 529-533.
    Also: Surgical papers (Halsted), Balt., 1924, i, 71-112.
37. Spurious ankylosis of the jaws. Exhibition of a case at The Johns Hopkins Hospital Medical Society, Baltimore, February 2, 1891.
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 62-63.
    Also: Surgical papers (Halsted), Balt., 1924, ii, 479-480.
38. Radical operation for hernia. Exhibition of ten cases at The Johns Hopkins Hospital Medical Society, Baltimore, February 16, 1891. (Appears as a title.)
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 63.
39. Iodoform oil injections for tuberculosis of hip. Transplantation of bone from a dog to the tibia of a boy for repair of an ununited fracture. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, March 16, 1891. (Appears only as a title.)
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 104.
40. Osteo-plastic operations for the obliteration of a very large involucral cavity. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, October 5, 1891.
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 160.
    Also: Surgical papers (Halsted), Balt., 1924, ii, 481-482.
41. Plastic operation for the obliteration of a large cavity in the lower end of the femur. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, October 5, 1891.
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 160.
    Also: Surgical papers (Halsted), Balt., 1924, i, 114.
42. A suppurating compound, comminuted fracture into the ankle joint treated without drainage. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, October 5, 1891.
    Johns Hopkins Hosp. Bull., Balt., 1891, ii, 160-161.
    Also: Surgical papers (Halsted), Balt., 1924, i, 115-116.

43. A needle-holder for Hagedorn's needles. Brief remarks in discussion of Dr. J. Whitridge William's demonstration, "A new needle-holder." The Johns Hopkins Hospital Medical Society, Baltimore, February 2, 1891.

Johns Hopkins Hosp. Bull., Balt., 1891, ii, 63.

Also: Surgical papers (Halsted), Balt., 1924, i, 49.

1892

44. Colles' fracture. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, November 2, 1891.

(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1892, iii, 30.

45. Excision of some of the veins of the cord in the operation for the radical cure of inguinal hernia. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, January 18, 1892.

(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1892, iii, 76.

Also: (Abstr.) Surgical papers (Halsted), Balt., 1924, i, 264.

46. Ligation of the first portion of the left subclavian artery and excision of a subclavio-axillary aneurism. Exhibition and report of a case at The Johns Hopkins Hospital Medical Society, Baltimore, May 23, 1892.

Johns Hopkins Hosp. Bull., Balt., 1892, iii, 93-94.

Also: Surgical papers (Halsted), Balt., 1924, i, 311-313.

47. The Johns Hopkins Hospital Reports—Report in surgery. Baltimore, March, 1891.

(Abstr.) Centralbl. f. Chir., Leipz., 1892, xix, 202-208.

48. Review of book "Anleitung zur aseptischen Wundbehandlung" by Dr. C. Schimmelbusch, and remarks concerning the introduction of "Gut wool."

Johns Hopkins Hosp. Bull., Balt., 1892, iii, 63-64.

Also: Surgical papers (Halsted), Balt., 1924, i, 50-54.

1893

49. The radical cure of inguinal hernia in the male. Presented at the Annual Meeting of the Medical Chirurgical Faculty of Maryland, Easton, Md., November 17, 1892.

Johns Hopkins Hosp. Bull., Balt., 1893, iv, 17-24. (Reprinted.)

Also: Ann. Surg., Phila., 1893, xvii, 542-556.

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1894, xxi, 234-235.

Also: Surgical papers (Halsted), Balt., 1924, i, 265-282.

50. Laparotomy for intussusception. Subcutaneous stitch. Exhibition of cases before The Johns Hopkins Hospital Medical Society, Baltimore, January 16, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 43.
51. Tuberculous knee-joint. Exhibition of surgical cases at The Johns Hopkins Hospital Medical Society, Baltimore, April 3, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 97-98.
    Also: Surgical papers (Halsted), Balt., 1924, i, 138.
52. Goitre. Exhibition of surgical cases at The Johns Hopkins Hospital Medical Society, Baltimore, April 3, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 97-98.
53. Operative treatment of old dislocations of elbow. Exhibition of surgical case at The Johns Hopkins Hospital Medical Society, Baltimore, April 3, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 97-98.
    Also: Surgical papers (Halsted), Balt., 1924, i, 55.
54. Recurrent volvulus. Brief remarks in discussion of Dr. J. M. T. Finney's paper, "Recurrent volvulus." The Johns Hopkins Hospital Medical Society, Baltimore, January 16, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 28.
    Also: Surgical papers (Halsted), Balt., 1924, i, 220-221.
55. The bacteriacidal properties of the blood; the effect of strangulation of tissues upon local infection. Brief remarks in discussion of Dr. Robert W. Johnson's paper, "Twelve accident cases treated by the blood-clot method." The Clinical Society of Maryland, Baltimore, January 20, 1893.
    Maryland M. J., Balt., 1893, xxviii, 404.
56. Gastro-enterostomy and adhesions. Brief remarks in discussion of Dr. J. M. T. Finney's paper, "Gastro-enterostomy for cicatrizing ulcer of the pylorus." The Johns Hopkins Hospital Medical Society, Baltimore, February 20, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1893, iv, 54.

1894

57. Two cases of excision of the knee-joint in which Hansmann's plates with ordinary screws were employed. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 8, 1893.
    Johns Hopkins Hosp. Bull., Balt., 1894, v, 31-32.
    Also: Surgical papers (Halsted), Balt., 1924, i, 56-57.

58. A diagnostic sign in appendicitis. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 18, 1893.
Johns Hopkins Hosp. Bull., Balt., 1894, v, 32.
Also: Surgical papers (Halsted), Balt., 1924, i, 222-223.

59. A postscript to the report on appendicitis. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, April 2, 1894.
Johns Hopkins Hosp. Bull., Balt., 1894, v, 113-114.
Also: Surgical papers (Halsted), Balt., 1924, i, 224-226.

60. Operative treatment of cancer of the breast. Presented before the Medical and Chirurgical Faculty of the State of Maryland, Baltimore, April, 1894.
(Abstr.) Maryland M. J., Balt., 1894, xxi, 109.

61. Report of twelve cases of complete radical cure of hernia, by Halsted's method, of over two years' standing. Silver wire sutures. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, May 7, 1894.
Johns Hopkins Hosp. Bull., Balt., 1894, v, 98-99.
Also: Surgical papers (Halsted), Balt., 1924, i, 283-285.

62. The results of operations for the cure of cancer of the breast performed at The Johns Hopkins Hospital from June, 1889, to January, 1894. Presented before the Clinical Society of Maryland, Baltimore, April 20, 1894.
Johns Hopkins Hosp. Rep., Balt., 1894-1895, iv, 297-350. (Reprinted.)
Also: Ann. Surg., Phila., 1894, xx, 497-555. (Reprinted.)
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1895, xxii, 336-338.
Also: (Abstr.) Am. Pract. Surg. (Bryant, J. D., and Buck, A. H.), N. Y., 1909, vi, 550-553.
Also: Surgical papers (Halsted), Balt., 1924, ii, 3-50.

63. Circulatory congestion of the head and neck with protrusion of eyeballs in cases receiving tremendous abdominal pressure. Brief remarks in discussion of Dr. Joseph C. Bloodgood's paper, "Rupture of right abdominal muscle." The Johns Hopkins Hospital Medical Society, Baltimore, December 18, 1893.
Johns Hopkins Hosp. Bull., Balt., 1894, v, 33.

1895

64. Operative treatment of hernia.
Am. J. M. Sc., Phila., 1895, n. s., cx, 13-17. (Reprinted.)
Also: Surgical papers (Halsted), Balt., 1924, i, 286-290.

65. The glottis kept open by foreward pressure on the angle of the jaw. Atropin, morphine, and chloroform in anaesthesia. Remarks in discussion of Dr. H. A. Hare's paper, "The posture of the head in accidents when the patient is under an anaesthetic." The Johns Hopkins Hospital Medical Society, Baltimore, November 9, 1894.
Johns Hopkins Hosp. Bull., Balt., 1895, vi, 4.

66. Concerning inflammation and suppuration. Remarks in discussion of Dr. Roswell Park's paper, "On the consequences of hyperaemia and the pathology of inflammation and suppuration." American Surgical Association, New York, May 28-30, 1895.
Tr. Am. Surg. Ass., Phila., 1895, xiii, 249-251.
Also: Surgical papers (Halsted), Balt., 1924, i, 58-60.

67. Concerning the operative treatment of hernia. Brief remarks in discussion of Dr. Christian A. Fenger's paper, "Causes of hernia of the bladder met with during operations for inguinal and femoral hernia." American Surgical Association, New York, May 28-30, 1895.
Tr. Am. Surg. Ass., Phila., 1895, xiii, 343-344.
Also: Surgical papers (Halsted), Balt., 1924, i, 291.

68. Irrigations with bichloride solutions. Remarks in discussion of Dr. J. M. T. Finney's paper, "Pyarthrosis." The Johns Hopkins Hospital Medical Society, Baltimore, October 7, 1895.
Johns Hopkins Hosp. Bull., Balt., 1895, vi, 164.
Also: Surgical papers (Halsted), Balt., 1924, i, 61-62.

1896

69. Three cases of plastic surgery:
Plastic operation for extensive burn of neck.
Plastic operation for the closure of a fistula.
A case of epispadias.
Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, November 4, 1895.
Johns Hopkins Hosp. Bull., Balt., 1896, vii, 25-26.
Also: Surgical papers (Halsted), Balt., 1924, ii, 483-485.

70. An experimental study of the thyroid gland of dogs with especial consideration of hypertrophy of this gland.
Johns Hopkins Hosp. Rep., Balt., 1896, i, 372-408. (Reprinted.)
Also: Surgical papers (Halsted), Balt., 1924, ii, 105-145.

71. The operative treatment of gall-stones. Brief remarks before the Medical and Chirurgical Faculty of the State of Maryland, Baltimore, April 30, 1896.
    Maryland M. J., Balt., 1896, xxxv, 101.
72. Rectal tuberculosis. Brief remarks in discussion of Dr. S. T. Earle's paper, "Two cases of tuberculous fistula in ano." The Medical Chirurgical Faculty of the State of Maryland, Baltimore, April 30, 1896.
    Maryland M. J., Balt., 1896, xxxv, 101-102.

1897

73. Compensatory hypertrophy of the thyroid gland, with demonstrations. Remarks before the Baltimore Medical Association, Baltimore, December 14, 1896.
    Maryland M. J., Balt., 1897, xxxvii, 67.
74. Remarks concerning gall-stones and biliary surgery. Remarks in discussion of Dr. F. Lange's paper, "The surgical significance of gall-stones." The Johns Hopkins Hospital Medical Society, Baltimore, October 19, 1896.
    Johns Hopkins Hosp. Bull., Balt., 1897, viii, 31.
    Also: Surgical papers (Halsted), Balt., 1924, ii, 427-429.

1898

75. Inflated rubber cylinders for circular suture of the intestine. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 13, 1897.
    Johns Hopkins Hosp. Bull., Balt., 1898, ix, 25-27.
    Also: Phila. M. J., 1898, i, 63-68. (Reprinted.)
    Also: (Abstr.) Centralbl. f. Chir., Leipz., 1898, xxv, 740-741.
    Also: Surgical papers (Halsted), Balt., 1924, i, 227-232.
76. Miniature hammers and the suture of the bile ducts. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, December 13, 1897.
    Johns Hopkins Hosp. Bull., Balt., 1898, ix, 67-69. (Reprinted.)
    Also: Phila. M. J., 1898, i, 608-611.
    Also: Surgical papers (Halsted), Balt., 1924, ii, 430-433.
77. A clinical and histological study of certain adenocarcinomata of the breast; and a brief consideration of the supraclavicular operation and of the results of the operations for cancer of the breast from 1889-1898 at The Johns Hopkins Hospital. Presented at the American Surgical Association, New Orleans, April 20, 1898.

Tr. Am. Surg. Ass., Phila., 1898, xvi, 114-181. (Reprinted.)
Also: Ann. Surg., Phila., 1898, xxviii, 557-576.
Also: Phila. M. J., 1898, i, 762.
Also: (Abstr.) J. Am. M. Ass., Chicago, 1898, xxx, 1106-1107.
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1899, xxvi, 679-680.
Also: (Abstr.) Month. Cycl. Pract. Med., 1899, xiii, n. s., 28.
Also: Surgical papers (Halsted), Balt., 1924, ii, 51-65.

78. The bacteriology of cystitis. Brief remarks in discussion of Dr. N. Senn's paper, "The etiology and classification of cystitis." The American Surgical Association, New Orleans, April 19, 1898.
Tr. Am. Surg. Ass., Phila., 1898, xvi, 50.
Also: (Abstr.) J. Am. M. Ass., Chicago, 1898, xxx, 1106.

79. Concerning drainage and drainage tubes. Remarks in discussion of Dr. Charles A. Power's paper, "The question of operative interference in recent simple fractures of the patella." The American Surgical Association, New Orleans, April 19, 1898.
Tr. Am. Surg. Ass., Phila., 1898, xvi, 103.
Also: (Abstr.) J. Am. M. Ass., Chicago, 1898, xxx, 1106.
Also: Surgical papers (Halsted), Balt., 1924, i, 63.

80. The pancreatic ducts; action of the pancreatic juice on the skin. Remarks in discussion of Dr. Harvey Cushing's paper, "Traumatic rupture of the pancreas; formation of haemorrhagic cyst; operation; pancreatic fistula; recovery." The American Surgical Association, New Orleans, April 20, 1898.
Tr. Am. Surg. Ass., Phila., 1898, xvi, 232.
Also: (Abstr.) J. Am. M. Ass., Chicago, 1898, xxx, 1108.

81. Gunshot injury of the spine. Brief remarks in discussion of Dr. T. F. Prewitt's paper, "Gunshot injuries of the spine, with report of a case." The American Surgical Association, New Orleans, April 21, 1898.
(Abstr.) J. Am. M. Ass., Chicago, 1898, xxx, 1109.

1899

82. Contribution to the surgery of the bile passages, especially of the common bile-duct. Read before the Surgical Section of the Suffolk District Medical Society, Boston, May 3, 1899.
Boston M. & S. J., 1899, cxli, 645-654. (Discussion, 661-664.)
Also: Johns Hopkins Hosp. Bull., Balt., 1900, xi, 1-11. (Reprinted.)
Also: Surgical papers (Halsted), Balt., 1924, ii, 434-462.

83. The forceps of Laplace and intestinal anastomosis. Remarks in discussion of Dr. Earnest Laplace's paper, "A demonstration of intestinal anastomosis by means of a new forceps." The Johns Hopkins Hospital Medical Society, Baltimore, February 6, 1899.
    Johns Hopkins Hosp. Bull., Balt., 1899, x, 114-115.
    Also: Maryland M. J., Balt., 1899, xl, 106.

1900

84. A contribution to the surgery of foreign bodies. I. Stellate calculi in form resembling jackstones removed from the bladder by suprapubic lithotomy. II. Two hundred and eight foreign bodies and seventy-four grammes of glass extracted from the stomach by gastrotomy. Recovery. Prepared for "Contributions to the Science of Medicine, dedicated by his pupils to William Henry Welch upon the Twenty-Fifth Anniversary of his Doctorate."
    Johns Hopkins Hosp. Rep., Balt., 1900, ix, 1047-1059. (Reprinted.)
    Also: Surgical papers (Halsted), Balt., 1924, i, 122-131.
85. Successful removal of a large foreign body from the head. A letter to the Editor.
    Phila. M. J., 1900, v, 4. (Reprinted.)
    Also: Surgical papers (Halsted), Balt., 1924, i, 121.
86. Excision of the anterior half of the head, neck, and upper portion of the trochanter of the right femur by frontal section for tuberculosis of the hip joint. Remarks in discussion of Dr. Joseph C. Bloodgood's paper, "Early exploratory operations in tuberculosis of the hip." The Johns Hopkins Hospital Medical Society, Baltimore, May 8, 1899.
    Johns Hopkins Hosp. Bull., Balt., 1900, xi, 19-20.
    Also: Surgical papers (Halsted), Balt., 1924, i, 139-141.

1901

87. Retrojection of bile into the pancreas, a cause of acute haemorrhagic pancreatitis. Presented at the Clinical Society of Maryland, Baltimore, March 15, 1901.
    Johns Hopkins Hosp. Bull., Balt., 1901, xii, 179-182. (Reprinted.)
    Also: Maryland M. J., Balt., 1901, xliv, 312-314.
    Also: Surgical papers (Halsted), Balt., 1924, ii, 463-468.

88. A brief consideration of the cases of cancer of the breast treated at The Johns Hopkins Hospital since 1889. Presented at the American Surgical Association, Baltimore, May 7-9, 1901.
Tr. Am. Surg. Ass., Phila., 1901, xix, 26.
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1902, xxix, 981.

89. Bisection of large tumors as an aid to enucleation. Brief remarks in discussion of Dr. Howard A. Kelly's paper, "Bisection of the uterus—exhibition of specimens." Clinical Society of Maryland, Baltimore, March 15, 1901.
Maryland M. J., Balt., 1901, xliv, 316.

90. Local anaesthesia with weak solutions of cocaine. Brief remarks in discussion of Dr. Rudolph Matas' paper, "Traumatic arterio-venous aneurisms of the subclavian vessels, with an analytical study of fifteen reported cases, including one operated by Rudolph Matas." American Surgical Association, Baltimore, May 7-9, 1901.
Tr. Am. Surg. Ass., Phila., 1901, xix, 293-294.
Also: Surgical papers (Halsted), Balt., 1924, i, 178.

91. Remarks on 780 cases of hernia, operated at The Johns Hopkins Hospital. Brief remarks in discussion of Dr. William B. Coley's paper, "Radical cure of inguinal and femoral hernia, with a report of eight hundred and forty-five cases." American Surgical Association, Baltimore, May 7-9, 1901.
Tr. Am. Surg. Ass., Phila., 1901, xix, 357.

1902

92. Egg-sized gallstone of the common bile duct; liver abscess. Exhibition of cases at The Johns Hopkins Hospital Medical Society, Baltimore, January 20, 1902.
Johns Hopkins Hosp. Bull., Balt., 1902, xiii, 147.

93. A case which may point out a new disease of the lymph glands. Report of a case before the New York Academy of Medicine, 1902.
Gaillard's Med. J., N. Y., 1902, lxxvii, 217-218.

94. Closure of the cystic duct after excision of the gall bladder. Remarks in discussion of Dr. J. M. T. Finney's paper, "Excision of the gall bladder." The Johns Hopkins Hospital Medical Society, Baltimore, October 7, 1901.
Johns Hopkins Hosp. Bull., Balt., 1902, xiii, 54-55.
Also: Surgical papers (Halsted), Balt., 1924, ii, 469-470.

1903

95. The cure of the more difficult as well as the simpler inguinal ruptures. Johns Hopkins Hosp. Bull., Balt., 1903, xiv, 208-214. (Reprinted.)
Also: (Abstr.) Month. Cycl. Pract. Med., Phila., 1903, xvii, n. s., 379.
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1904, xxxi, 261.
Also: Surgical papers (Halsted), Balt., 1924, i, 292-305.

96. The X-ray treatment of cancer. Brief remarks in discussion of Dr. Codman's paper, "The X-rays at the Massachusetts General Hospital." The Johns Hopkins Hospital Medical Society, Baltimore, February 2, 1903.
Maryland M. J., Balt., 1903, xlvi, 282.

1904

97. Pathology and treatment of benign tumors of bone with cyst formation. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, May 16, 1904.
Johns Hopkins Hosp. Bull., Balt., 1904, xv, 262-263.
Also: Maryland M. J., Balt., 1904, xvlii, 344.

98. The training of the surgeon. The Annual Address in Medicine, delivered at Yale University, New Haven, Conn., June 27, 1904.
Johns Hopkins Hosp. Bull., Balt., 1904, xv, 267-275. (Reprinted.)
Also: Am. Med., Phila., 1904, viii, 69-75.
Also: Surgical papers (Halsted), Balt., 1924, ii, 512-531.

99. Carcinoma preceded by a history of gastric ulcer. Brief remarks in discussion of Dr. Joseph C. Bloodgood's paper, "An early case of ulcer of the stomach." The Johns Hopkins Hospital Medical Society, Baltimore, May 16, 1904.
Johns Hopkins Hosp. Bull., Balt., 1904, xv, 347-348.
Also: Maryland M. J., Balt., 1904, xlvii, 345.

1905

100. Partial occlusion of the aorta. Brief remarks on experimental work before The Johns Hopkins Hospital Medical Society, Baltimore, March 20, 1905.
(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1905, xvi, 202.
Also: (Abstr.) Maryland M. J., Balt., 1905, xlviii, 232.

101. The partial occlusion of blood vessels especially of the abdominal aorta. A preliminary report. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, March 20, 1905.

Johns Hopkins Hosp. Bull., Balt., 1905, xvi, 346-347.

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1905, xxxii, 1384.

Also: Surgical papers (Halsted), Balt., 1924, i, 314-317.

102. The clinical features of thyroid hypertrophy. Presented at The Johns Hopkins Hospital Medical Society, Baltimore, May 15, 1905.

(Abstr.) Johns Hopkins Hosp. Bull., Balt., 1905, xvi, 288.

Also: (Abstr.) Maryland M. J., Balt., 1905, xlviii, 374.

103. Results of the open-air treatment of surgical tuberculosis. Presented at the First Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, Washington, D. C., May 18-19, 1905.

Am. Med., Phila., 1905, x, 937-946. (Reprinted.)

Also: Nat. Ass. Study & Prevent. Tuberculosis, Trans., N. Y., 1906, i, 281-303. (Reprinted.)

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1906, xxxiii, 880.

Also: Surgical papers (Halsted), Balt., 1924, i, 142-163.

1906

104. The results of the complete and incomplete occlusion of the abdominal and thoracic aortas by metal bands. Presented at the Section on Surgery and Anatomy of the American Medical Association, Boston, June 5-8, 1906.

Tr. Sect. Surg. & Anat., Am. M. Ass., Chicago, 1906, 587-590.

Also: (Abstr.) J. Am. M. Ass., Chicago, 1906, xlvii, 2147-2148.

Also: Surgical papers (Halsted), Balt., 1924, i, 318-320.

105. Hansmann's plate for fracture of the femur. Brief remarks in discussion of Dr. Whitman's paper, "The treatment of fractures of the neck of the femur." The Johns Hopkins Hospital Medical Society, Baltimore, March 5, 1906.

Maryland M. J., Balt., 1906, xlix, 280-281.

106. Blood vessel surgery and manual dexterity. Brief remarks in discussion of Dr. Alexis Carrel's paper, "Surgery of the blood vessels and its application to the changes of circulation and transplantation of organs." The Johns Hopkins Hospital Medical Society, Baltimore, April 23, 1906.

Johns Hopkins Hosp. Bull., Balt., 1906, xvii, 237.

Halsted, W. S., and Sowers, W. F. M.

107. Experimental partial occlusion of arteries. Presented before the Southern Surgical and Gynecological Association, Baltimore, December 12, 1906.
Tr. South. Surg. & Gynec. Ass., Phila., 1906, xix, 486-490.
Internat. J. Surg., N. Y., 1907, xx, 186-188.

1907

108. Hypoparathyreosis, status parathyreoprivus and transplantation of the parathyroid glands.
Am. J. M. Sc., Phila. & N. Y., 1907, n. s., cxxxiv, 1-12. (Reprinted.)
Also: Surgical papers (Halsted), Balt., 1924, ii, 150-163.

109. The results of radical operations for the cure of carcinoma of the breast. Presented at the American Surgical Association, Washington, D. C., May 8, 1907.
Tr. Am. Surg. Ass., Phila., 1907, xxv, 61-79. (Reprinted.)
Also: Ann. Surg., Phila., 1907, xlvi, 1-19.
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1908, xxxv, 476-477.
Also: Surgical papers (Halsted), Balt., 1924, ii, 66-81.

110. Relation of goitre and chronic rheumatism; the duration of the post-operative period in the estimation of recovery as due to the operation. Brief remarks in discussion of Dr. W. S. Baer's exhibition of cases: sarcoma of the dura; snapping joints; a case of Pott's disease with laminectomy and complete recovery. Section on Clinical Medicine and Surgery of the Medical and Chirurgical Faculty of the State of Maryland, Baltimore, December 7, 1906.
Maryland M. J., Balt., 1907, l, 72.

111. Preservation of the parathyroids during thyroidectomy. Remarks in discussion of Dr. C. H. Mayo's paper, "Treatment of the posterior capsule of the gland in thyroidectomy, based on 375 operations for goitre." American Surgical Association, Washington, D. C., May 7-9, 1907.
Tr. Am. Surg. Ass., Phila., 1907, xxv, 60.
Also: (Abstr.) Centralbl. f. Chir., Leipz., 1908, xxxv, 376.
Also: Surgical papers (Halsted), Balt., 1924, ii, 146-147.

112. Surgical tetany and the parathyroids. Remarks in discussion of papers by Drs. S. P. Beebe, Wm. G. MacCallum, Lewellys F. Barker, Robert B. Preble, and Albert Kocher in the symposium on goitre, at the Joint Session of Sections on Practice of Medicine, Surgery, and Anatomy and Pathology, and Physiology of the American

Medical Association, the 58th Annual Session, Atlantic City, N. J., June, 1907.

J. Am. M. Ass., Chicago, 1907, xlix, 1243-1244.

Also: Surgical papers (Halsted), Balt., 1924, ii, 148-149.

Halsted, W. S., and Evans, H. M.

113. The parathyroid glandules. Their blood supply and their preservation in operation upon the thyroid gland.

Ann. Surg., Phila., 1907, xlvi, 489-506. (Reprinted.)

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1908, xxxv, 11-12.

Also: Surgical papers (Halsted), Balt., 1924, ii, 164-177.

1908

114. The transplantation of the parathyroid glands in dogs. Presented at the Society for Experimental Biology and Medicine, 28th Meeting, New York, April 15, 1908.

(Abstr.) Proc. Soc. Exper. Biol. & Med., N. Y., 1908, v, 74-77. (Reprinted.)

Also: Proc. Path. Soc., Phila., 1908, n. s., xi, 109-114. (Discussion, 127.)

115. Some results of recent experimental work on the parathyroids. Presented before the Baltimore City Medical Society, Section on Clinical Medicine and Surgery, Baltimore, December 4, 1908. (Appears only as title.)

Bull. Med. & Chir. Fac. Maryland, Balt., 1908, i, 107.

Also: Maryland M. J., Balt., 1908, li, 536.

116. Surgical tuberculosis and tuberculin. Brief remarks in discussion of papers by Dr. Louis V. Hamman, Dr. Rufus I. Cole, and Dr. R. Tunstall Taylor, "The use of tuberculin in diagnosis and treatment." The Baltimore City Medical Society, Section on Clinical Medicine and Surgery, Baltimore, December 6, 1908.

Maryland M. J., Balt., 1908, li, 32.

1909

117. Auto- and isotransplantation, in dogs, of the parathyroid glandules.

J. Exp. Med., Lancaster, Pa., 1909, xi, 175-199. (Reprinted.)

Also: Surgical papers (Halsted), Balt., 1924, ii, 178-200.

118. Partial, progressive, and complete occlusion of the aorta and other large arteries in the dog by means of the metal band.

J. Exp. Med., Lancaster, Pa., 1909, xi, 373-391. (Reprinted.)

Also: Surgical papers (Halsted), Balt., 1924, i, 401-416.

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Tr. Am. Surg. Ass., Phila., 1909, xxvii, 111-115.

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1910, xxxvii, 632-633.

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Tr. Am. Surg. Ass., Phila., 1909, xxvii, 69.

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Tr. Am. Surg. Ass., Phila., 1909, xxvii, 75-77.

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Tr. Am. Surg. Ass., Phila., 1909, xxvii, 85-86.

Also: Surgical papers (Halsted), Balt., 1924, i, 13.

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Tr. Am. Surg. Ass., Phila., 1909, xxvii, 308-309.

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Tr. Am. Surg. Ass., Phila., 1910, xxviii, 256-261. Discussion, 295-298. (Reprinted.)

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Med. Rec., N. Y., 1910, lxxvii, 511.

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Also: Surgical papers (Halsted), Balt., 1924, i, 325-328.

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Tr. Am. Surg. Ass., Phila., 1910, xxviii, 312.

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129. Epithelkörperchen. Remarks in discussion of papers by Dr. Theodor Kocher, Dr. Albert Kocher, and Dr. Klose on "Ueber Morbus Basedow." 40th Congress der deutsche Gesellschaft für Chirurgie, Berlin, April 19, 1911.

Verhandl. d. deutsch. Gesellsch. f. Chir., Berl., 1911, xl, Theil i, 45-47.

Also: Surgical papers (Halsted), Balt., 1924, ii, 201-203.

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Tr. South. Surg. & Gynec. Ass., Phila., 1911, xxiv, 234.

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J. Exp. Med., Lancaster, Pa., 1912, xv, 205-215. (Reprinted.)

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1912, xxxix, 1146-1147.

Also: Surgical papers (Halsted), Balt., 1924, ii, 204-212.

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J. Exp. Med., Lancaster, Pa., 1912, xv, 216-224. (Reprinted.)

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1912, xxxix, 1180-1181.

Also: Surgical papers (Halsted), Balt., 1924, i, 238-245.

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134. Developments in the skin-grafting operation for mammary cancer. Presented at the American Surgical Association, Montreal, Canada, May 29, 1912.

Tr. Am. Surg. Ass., Phila., 1912, xxx, 287-293. (Reprinted.)

Also: (Abstr.) Centralbl. f. Chir., Leipz., 1913, xl, 1984.

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Also: Surgical papers (Halsted), Balt., 1924, ii, 213-219.

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